SCIENTIFIC AMERICAN

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THE NEW LONDON DOUBLE TRACK RAILROAD BRIDGE AND DRAW SPAN.

We illustrate in the present issue the great railroad bridge crossing the Thames River at New London, Conn. Hitherto the "Shore Line" trains on the Providence and Boston routes have been ferried across the stream on a special ferryboat, which was capable of carrying an entire train of cars. The crossing of the "Groton Ferry" has come to be looked for as a regular incident of the trip between Boston and New York, and has perhaps been welcomed often by the passenger on day trains as an agreeable variety in the route. But in a few weeks the boat will take her last trip, and the trains will then cross the estuary

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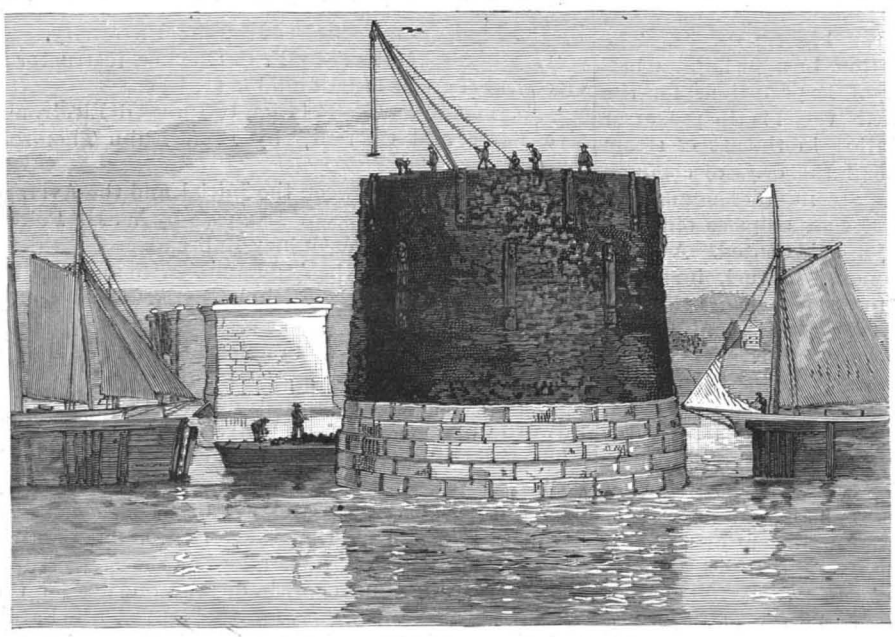
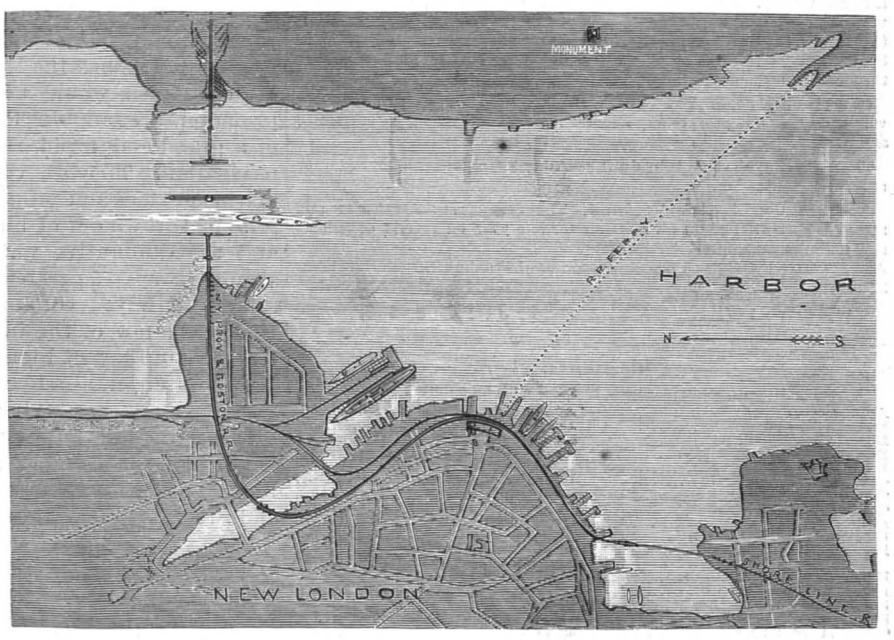
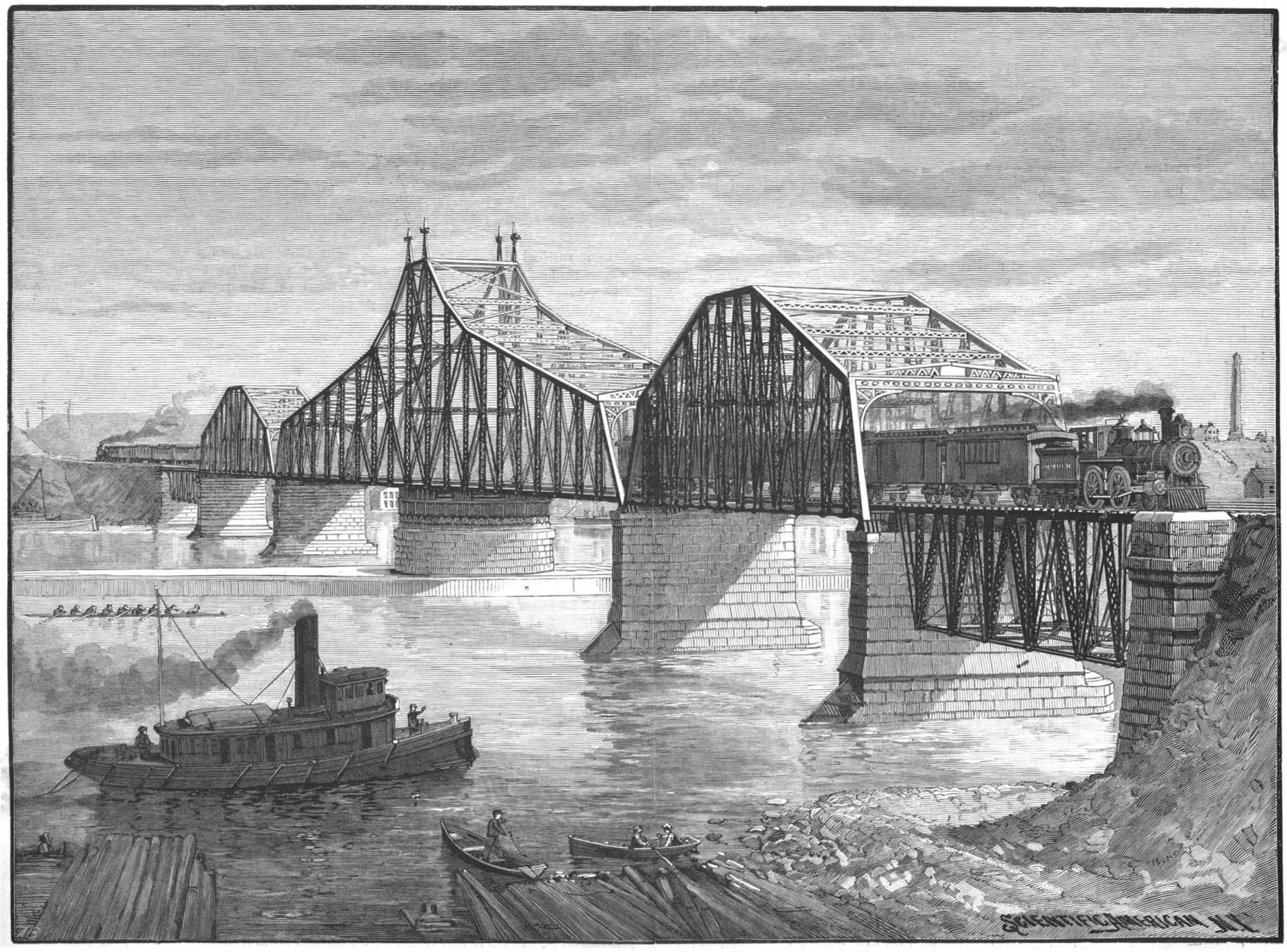


LOADING THE PIVOT PIER WITH 2,700 TONS OF PIG IRON.



MAP OF NEW LONDON, SHOWING THE NEW AND OLD ROUTES.



THE NEW LONDON DOUBLE TRACK RAILROAD BRIDGE—THE LARGEST DRAWBRIDGE IN THE WORLD.

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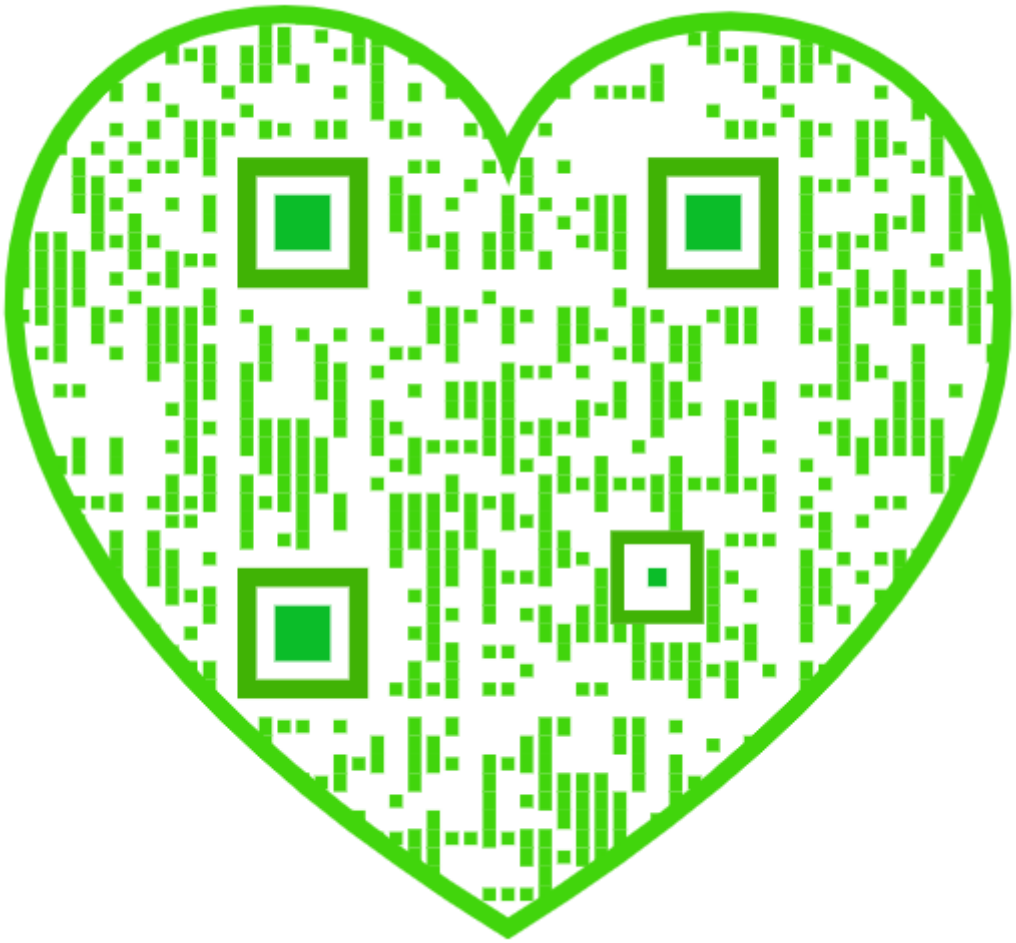

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AN EXPECTED REVOLUTION IN STEAM NAVIGATION.

A new and interesting experiment in marine propulsion is to be tried soon in this harbor. We allude to the new water jet boat invented by Dr. Walter M. Jackson, of this city. The vessel is 100 ft. long, 100 tons burden, with a boiler intended to yield 1,500 h. p., applied to a Worthington pump, and used to eject a small stream of water—a three-quarter inch jet—from the stern post, at the keel line. The water is to issue under the enormous pressure of 2,500 lb. to the square inch, and a speed of between thirty and forty miles an hour is expected by the owners—a velocity far in excess of any other craft afloat. The stern water jet issues from a faucet which takes the place of a rudder. The faucet is operated by a lever in the pilot house. A jet pipe also extends from the main pump to the bow, where a similar faucet is located, also connected with the pilot house lever. Thus the pilot has absolute control of the vessel. By simply moving the lever, the boat can be instantly started, turned, stopped, backed, or made to spin around on its axis like a top. All this without stopping the driving pump. No jarring, noise, or vibration is felt, even at the highest speeds. The new boat is named the Evolution, but, perhaps, a better cognomen would be Great Expectations, for the promoters are sanguine the little vessel is the precursor of a grand and rapid revolution in the art of steam navigation. They are confident the days of common marine engines and propellers are numbered, and will soon be thrown out of all first class ships as old iron, and the diminutive water jet substituted. A large saving in space, greater economy in fuel, increased safety, improved comforts for passengers, are mentioned as a few of the important results that will attend this outflow of high pressure water.

The water jet, as a hydraulic system for the propulsion of vessels, has been many times tried with excellent results, but has not proved economical as compared with the ordinary marine engine and propeller. In the back numbers of the SCIENTIFIC AMERICAN and SUPPLEMENT will be found particulars of some of these hydraulic motors, with illustrations of the vessels (see, for example, SUPPLEMENT, Nos. 308, 354, 415, 489, also 440, 561). In most of these cases it has been the aim of the projectors to make use of as large a water jet as possible, and a low water pressure, which involved the movement and discharge of a great volume and weight of water.

Thus a water jet of 5·33 square feet area and a velocity of water discharge of 30 feet per second has been employed. This was in accordance with high scientific authority, such as Prof. Rankine, who maintains the most efficient propeller is that which sends the largest volume of water astern at the slowest speed. A variety of reasons and calculations have been put forth by others to prove that the small water jet, with high pressure and high speed, cannot possibly be as effective or economical as the big pipe and great weight of slow water. But it is a curious fact that in several subsequent experiments reduced water jets (7½ inches) and higher water velocity (66 feet per second) have given better results.

Dr. Jackson's scheme involves a radical departure from the hitherto accepted theories and calculations of water jet propulsion. In his new boat Evolution he reduces the old 5 square feet area discharge pipe down to an area of less than half a square inch (0·44 square inch), and increases the velocity of the water discharge from 30 feet per second up to 600 feet per second. By so doing he claims to secure superior practical results.

On the trials last summer of his small experimental boat Primavista, he used a jet only three-eighths of an inch in diameter, with a water pressure of 600 pounds to the inch, and obtained a speed of ten to twelve miles per hour. Many experiments were then made with this boat. The apparatus was crude and hurriedly made, but the results yielded much new, instructive, and valuable knowledge concerning the practical propelling powers of small jets at high velocities; and this new knowledge is embodied in the novel craft which is now receiving her finishing touches. One hundred thousand dollars, clean cash, have been put into the little vessel by the contributions of a number of able citizens, who fully believe in the correctness of the calculations of the ingenious inventor. Dr. Jackson is a man of varied scientific attainments, extensive mechanical experience, and good judgment. His inventions relating to gas machines have proved highly successful.

In this connection we would suggest to the naval authorities at Washington the propriety of supplying all of the new war ships with hydraulic jet pipes and pumps, as means for facilitating the navigation of the vessels and promoting safety. There appears to be no reason why bow and stern jets might not readily be put in, at no great cost, which would be highly useful in action and other emergencies requiring rapid maneuvering of the ships.

88,200 barrels of flour is the report of a recent one week's work for the mills at Minneapolis. Is there any other place in the world where such a large production is realized?

The Annual Meeting of the American Institute of Mechanical Engineers.

On May 21 the annual meeting of this society opened at the house of the American Society of Civil Engineers. The report of the secretary, Mr. R. W. Pope, was read. It showed 350 members in good standing, and an increase at the average rate of five per month, a very practical testimony to the increased interest taken in this branch of science by engineers. Mr. Edward Weston, the retiring president, after an address on the importance of enlarging the scope of the Institute's work, introduced his successor, Prof. Elihu Thomson, who, in his answering address, followed the same line of thought, and spoke of the opportunities before the Institute for work in the interest of electrical engineering. On May 22 the reading of papers began, the session beginning at 10 a. m. The following papers were read and discussed:

"Some Results with Secondary Batteries in Train Lighting," by Alexander S. Brown, Pennsylvania Railroad.

"The Inherent Defects of Lead Storage Batteries," by Dr. Louis Duncan, Johns Hopkins University.

"Motor Regulation," by F. B. Crocker, instructor in electrical engineering, Columbia College.

"Magnetism and its Relation to Induced Electromotive Force and Current," by Prof. Elihu Thomson, Lynn, Mass.

"The Relation between the Initial and the Average Efficiency of Incandescent Lamps," by W. H. Peirce, Chicago, Burlington & Quincy Railroad.

"The Efficiency of the Arc Lamp," with an introductory note by Prof. E. L. Nichols, by H. Nakano, Cornell University.

"The Spiral Coil Voltameter," by H. J. Ryan, Cornell University.

"The Personal Error in Photometry," by Prof. Edward L. Nichols, Cornell University.

The titles of the papers and the authors' names vouch for their interest. Prof. Nichols brought out one very practical point: that in the use of the Bunsen disk with reflecting mirrors the observer was liable to introduce a personal error if he adopted the stereoscopic method of inspecting the disk, or used one eye for the right side and the other for the left. This habit, which many photometrists fall into, is unquestionably a bad one, and its treatment by Prof Nichols is of interest to gas engineers as well as to electricians. In the evening a special session was held at the College of the City of New York to listen to Prof. H. A. Rowland's experimental lecture on "Modern Views with Respect to the Nature of Electrical Currents." Many well known electricians as well as the members of the Institute were present at this lecture, and the room was crowded to overflowing with an appreciative audience.

The Leland Stanford, Jr., University.

Mr. G. T. Shepley, the architect of the Leland Stanford, Jr., University, states in the San Francisco *Building Advertiser* that the work on the large dormitory in connection with the university has been commenced. The buildings completed, or nearly so, number fourteen, and consist of lecture rooms, reception rooms, laboratories, and all the requisite departments for a complete educational course. The dormitory will be situated about a thousand feet from the other buildings. It will be 275 by 145, four stories high, presenting a very imposing structure. The material used is San Jose stone. The building will accommodate two hundred students. Single rooms will be 18 by 26, and double rooms 24 by 26. Altogether there will be from one hundred and twenty-five to one hundred and fifty rooms. There will only be one dining room for the two hundred students, and this will occupy the central portion of the lower floor. The kitchen, laundries, etc., are in the basement; but, as the dining room is raised considerably above the floor on which it is situated, there will be plenty of light and air afforded for the basement. All the fifteen buildings will be heated by steam and lighted by electricity from one central station placed in the rear of the quadrangle. The university will not resemble any of the Eastern universities to any great extent. All the old colleges are built around quadrangles, and in this one point the Leland Stanford, Jr., University will resemble them, but in no other. There will be a magnificent view from all the sleeping rooms of the dormitories.

M. DE FONVIELLE has made very curious electrical experiments at the summit of the Eiffel tower. Some, it is considered, will lead to important considerations of a scientific character, which will be continued; others are of a more practical character. The atmosphere round the tower at this elevation is free from all influence of the soil, as would be the case at the top of a mountain, and the air is in an extraordinary active state of electricity. The tower will, it is said, be the most perfect conductor of electricity during a storm, and all within it will be in a state of entire immunity against all danger from lightning. The pretty idea has been suggested of having a carillon of bells at the top, which will play every two hours.

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The Paris Exhibition.:

A MAGNIFICENT AFFAIR—NOVELTIES IN THE AMERICAN SECTION—POVERTY OF THE ENGLISH SECTION.

PARIS, May 16.

It is conceded on all sides that this exhibition is a truly magnificent affair. No previous exhibition has approached it, either for size, beauty, or the quality and value of the exhibits. "I have been to every exhibition at which the United States government has been officially represented, and unhesitatingly assert that it very far surpasses anything attempted," said Mr. Thomas R. Pickering, the superintendent of machinery of the American section. "There never was so grand an exhibition, and it is questionable if there will ever be such another," said Mr. Doane, of Messrs. J. A. Fay & Co. The Eiffel tower, which so many people stigmatized as ugly and unattractive, is now conceded to be a thing of grace and beauty.

My first proceeding after the opening day, of which you have doubtless received full advices, was to take a general survey of the "Palais des Machins," whose immensity is exceedingly striking, and then to take a preliminary survey of the main buildings, so as to give your readers a general idea of the situation, which is as follows:

Except in the "Palais des Machins," the French are the most behind, and even there much of the machinery has been standing still, because there is no steam supply. This defect, however, will be remedied to-morrow.

The American section of machinery shows more progress in design and more valuable novelties than any other section, and many claim than all the others put together, and it seems to me at present writing that the claim is well founded.

The English section is small and possesses no distinguishing feature that I can so far see, except that of copying American designs, which is done to an altogether astonishing degree.

This is done with so much persistency, and old American designs are claimed as English with so much effrontery, while more advanced and superior American designs are so pooh-poohed by some of the English I have encountered here, that I determined to "speak out in meeting," and put this matter straight at once. So I took a hasty survey of the English machinery, with the following result:

On a milling machine I found the disk friction feeding device of William Sellers & Co., of Philadelphia, whose patent has expired. I also found a twist drill grinding machine whose sole novel feature is copied from the Sellers twist drill grinding machine. I also found twist drills with the line down the center of the flutes, after the Morse Twist Drill Company's patent. Another piece of piracy is a planer chuck that has been patented in England, and is commanding a large sale. One of its chief points, if not its chief one, is a direct copy of the main feature of Thomas' American patent planer chuck, this particular feature having been pointed out in the SCIENTIFIC AMERICAN, in 1875 or 1876. The rack feature now so common in American practice (the patent having expired) is copied, the only variation being that a single set screw is used, being placed central and abutting against a convex projection, so that the set screw point will bed fair, notwithstanding that the jaw may be at an angle for taper work. The Fox lathe as it was made in the United States seven or eight years ago appears, and several copied modifications of it, all being claimed as English. But the more recent American improvements are lacking, such, for example, as making the bed in two parts, so that the tail stock end may be taken up by raising that part of the bed.

I found turret head lathes here with no stop motion, the workman using his calipers, etc., in the old fashioned way. There are milling machines of English make carefully copied from American designs, with not a perceptible English feature about them. One or two of them have copied the movable bar for the dead center of the spindle. Another English machine has on it the American feature of a wire feed. Of a cutting-off machine copied from American practice an English machinist said to me, "It's a very good machine, but don't you think such machines an unnecessary refinement?" for otherwise I should have been told that it was an old English design that had been thrown away in England long ago. Your readers will doubtless picture this individual cutting up large rods or shafts in the blacksmith shop, chipping and filing the ends square for the centers, truing up the ends and cutting the pieces to length, and thus spending as much time and money on the job by the time it was ready to be turned up as the whole job would cost if a cutting-off machine had been used.

The editor of a prominent English engineering newspaper was here last week, and, I understand, expressed himself rather strongly on the poverty of the English section, and at least one engineer gave me to understand that the English machine tool makers would rather be excused from meeting their American competitors in any market unless the prices were overwhelmingly in their favor. There is only one American design of prominence that, so far as I have yet observed, is exhibited in the English section and not claimed as of English origin, and that is the Horton lathe chuck.

I next turned my attention to the United States section, to see what there was put forward as new that was copied from English or other foreign designs. I found nothing, but I found much that was new and very interesting indeed. I consider the cutting tool design and arrangement on Warner & Swazey's special lathe for brass work one of the best things I have seen for many a long day, and it is entirely original.

A walk through the other sections of the Palais des Machins shows that although the English are the greatest, they are not the only sinners, except it be in refusing credit to the American origin of their designs.

Amer et cie., Bale, Switzerland, have the Sellers rack and pinion (with its rolling contact) on their planer, but not on the pulley end of the pinion shaft, a combination, as is the case with the more recent Sellers' machines. The Ateliers de Construction Oerlikon, Zurich, have milling machines copying those of recent American design, and also lathes with the features of the "Fox" pattern. The tail stock of one lathe is constructed exactly like the dead center block used with American milling machine chucks. Baruquand, Paris, exhibits a screw machine having the Fox construction in connection with a Brown & Sharpe turret head and the American die and holder used in American screw machines.

A large amount of emery grinding machinery is shown, all embodying items of construction of distinctly American origin, with a variation of details. Of a great many of these it may be justly said that the parts that are new are not good, and the parts that are good are not new. The French show a great deal of emery grinding machinery, and, taken as a whole, it is very creditable indeed—much of it of the very first order and original. The Tanite emery wheel (Stroudsburg, Pa.) is a great favorite here.

Some of the details on French engines are, to my mind, decidedly objectionable, but the workmanship is, as far as I have at present observed, thoroughly good. Two engines of the Wheelock (U. S.) patent are here, one of them a pair of compound condensing engines and the other a high pressure. The latter has a flywheel of about 14 feet diameter, with internal gearing inside its rim, a feature for which there is, in my opinion, nothing favorable to be said.

"High piston speed" has not as yet taken much hold in either England or France, although the Armington-Sims engine (Providence, R. I.) is a favorite.

The straight line engine (Syracuse, N. Y.) will run as soon as it can get steam, and I think it will surprise a good many to see her speed and quiet running, notwithstanding that her cylinder is not bolted to the foundation, but merely rests on it. This engine has a flexible steel belt to drive her section of the line shafting (another American novelty), and this brings to mind that I did see one thing of English origin that has been copied at a comparatively recent date in the United States, and that is link leather belting, of which I hear very good reports.

American engineers here speak very highly of the design of the shafting girders, which, being continuous and flat on the top, furnish a track on which an electric hoisting crane runs. This crane is very highly spoken of by those who tried it when setting their machines on their foundations or unloading them from cars or trucks. The management of the United States commission here is giving a great deal of unalloyed satisfaction, and everybody in the United States section would be entirely happy if steam was only turned on, so that they could run their machines.

There is a large exhibit of French locomotives, the workmanship being good, and I wish I could say as much of the designs; but of this, more hereafter.

There are not as many printing presses here as there were at Philadelphia in 1876, and they are all indebted to the puncturing device of the Bullock press (American), which was first exhibited at the American Institute fair in 1868, I think, and that rendered web perfecting printing presses possible. There are a great many steam engines and paper making machines, and a very full line of grinding machinery.

The general American department is, it must be confessed, disappointing. Tiffany has a fine exhibit, and so have the Gorham Manufacturing Co. Messrs. Lyons, of New York, have a very fine exhibit of umbrellas, better than any others I have seen, notwithstanding that an English umbrella has been supposed to possess all the virtues possible in an umbrella. Around Ball & Goldsmith's corset exhibit I noticed a continuous crowd, and the Meriden Britannia Company's exhibit is well spoken of. There is one unobtrusive exhibit here that has no one attending it, that wood workers and carriage builders linger over, and well they may, for it is truly American and altogether meritorious. I refer to an exhibit of bent woods by H. G. Shepard, of New Haven, Conn. I heard a Frenchman say (after closely examining the specimens), "I would like to know that man. He is a master of his subject." Drake & Co. (St. Paul, Minn.) have a beautiful display of petrified woods, and no handsomer or more attractive memento of the exhibition can be found than one of their specimens, of which I will go more into detail at some future time.

Dunlap & Co. (New York City) exhibit a fine case of hats, and it is getting to be understood here that a better hat can be got in New York than either in London or Paris.

The French general department is not yet fully opened. The English general department is disappointing, while the Austria-Hungary department is simply elegance itself, and throws into the shade all competitors. Indeed, it cannot be said to have any competitors. The Russian department is very much better than one would anticipate, excelling in small bronzes.

There is a fine display of paintings and sculpture; but the galleries in the latter department are not open, while the department is in an unfinished state as far as the exhibits are concerned, heads, legs, and arms lying about in all directions. But the art departments are going to be very beautiful and delightful. There are not as yet any seats in the picture galleries; but there doubtless will be, as the galleries are so numerous that the crush there was at the Centennial galleries at Philadelphia in 1876 is not likely to be repeated here.

I heard to-day that in the construction of the Palais des Machins there were 60 men killed and 400 wounded, and perhaps it will do no harm at this late date to say that I was told in the machinery department of the Centennial exhibition of 1876 that during the hot spell, when the thermometer ranged from 100° to 104°, eleven people died from sunstroke received in that department in one day. Some people, however, attributed these deaths to the water, which in that year was anything but good.

There are no catalogues as yet, nor are the exhibits numbered in many cases, while in others there are two or more numbers, as is the case with statuary that has been exhibited at the Paris Salon, the old numbers remaining on a large yellow label, and some small white labels bearing different numbers accompanying them. Whether these latter are correct for this exhibition, there is nothing to indicate. JOSHUA ROSE.

New French War Vessels.

A steel cruiser named the Lalande has just been launched from the Chantiers de la Gironde, at Bordeaux. The Lalande is 316 feet 8 inches long by 31 feet 8 inches beam. Her displacement is 1,877 tons and her average draught of water is 16 feet 8 inches. Her engines, which were furnished by the Creusot Works, will work up to 6,000 horse power with forced draught, and when the engines are making 140 revolutions per minute it is expected that the ship will attain a speed of 19½ knots per hour. The Lalande will carry nine guns, of which three will be quick-firing and four revolvers. A torpedo cruiser named the Vantour has been launched at Toulon. Her hull, which is of steel, measures 226 feet 8 inches between perpendiculars. Her engines are to work up to 3,200 horse power, and she is expected to attain a speed of 20 knots. The Vantour will be fitted with four lance torpedo tubes and two Hotchkiss guns of long range. The Forbin cruiser has just made her trial trip. The average speed on the measured mile was 19¾ miles per hour.

Soapstone and Its Uses.

A writer in a London journal calls attention to the unappreciated uses and preservative qualities of soapstone, a material, he says, which possesses what may be regarded as extraordinary qualities in withstanding atmospheric influences, those especially which have so much to do with the corrosion of iron and steel, and from experiments made it is said that no other material is capable of taking hold of the fiber of iron and steel so readily and firmly as this. In China soapstone is largely used for preserving structures built of sandstone and other stones liable to crumble from the effect of the atmosphere; and the covering with powdered soapstone in the form of paint on some obelisks in that country, composed of stone liable to atmospheric deterioration, has been the means of preserving them intact for hundreds of years.

Electricity and Light.

Dr. Moser (*Eder's Jahrbuch fur Photographie*) draws attention to the following curious phenomena: The leaves of an electroscope are caused to diverge by charging with, say, 150 cells. On allowing a ray of direct sunlight to fall on the instrument the divergence is increased, and it returns to its original amount when the light is cut off. A common match (sulphur with phosphorus tip) will glow in the dark when brought close to a charged body such as the cover of an electrophorus. The mercury in a capillary electrometer falls when a ray of sunshine falls on it, just as it does when connected to the zinc of a battery. The effect is distinctly electrical, not thermal, as it vanishes when the upper and lower mercury columns are short-circuited by a wire.

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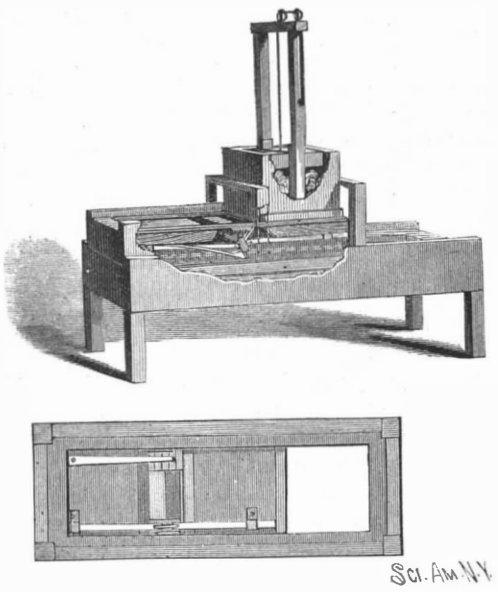
AN IMPROVED VEGETABLE CUTTER.

A machine for cutting up cabbages and other vegetables is illustrated herewith, and has been patented by Mr. Johann A. W. Iusti, the small figure showing a bottom view of the machine. The supporting frame has rails, on which a sliding frame is mounted to be reciprocated beneath a cabbage receptacle, a weight



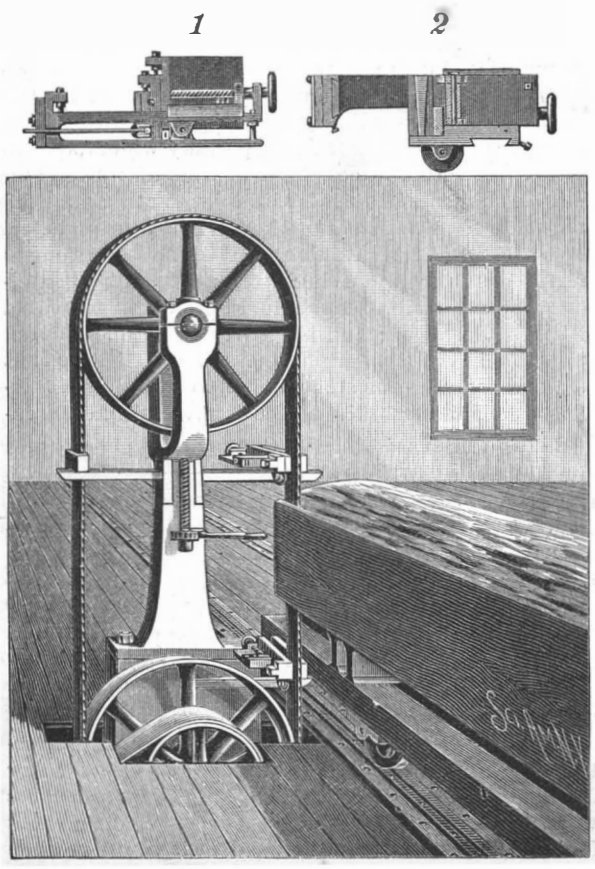
IUSTI'S VEGETABLE CUTTER.

box being held between uprights to press the vegetables in the receptacle against the cutters. In the bottom of the receptacle are strips having metallic friction plates, against which move friction plates on the reciprocating sliding frame, the bottom of the frame also having friction plates moving over friction plates on the rails. The frame has a transverse opening through which the knives alternately project, and through which the cabbage passes as it is cut. Beneath the frame is mounted a rock shaft carrying adjustable cutters, which may be moved to vary their projection, and may also be detached for sharpening. The cutters are alternately held in position for cutting by a spring. The frame may be reciprocated by hand or other power, and in each direction of movement of the frame one of the cutters projects upward through the slot, the other cutter being then out of the way.

For further particulars with reference to this invention, address the patentee, or Mr. C. Kerrison, Jr., Charleston, S. C.

AN IMPROVED GUIDE FOR BAND-SAWS.

A guide for band-saws, in which the parts may be readily and expeditiously manipulated, and the guide adjusted to any width of saw, is illustrated herewith, and has been patented by Mr. Charles R. Backer, of No. 1221 West Indiana Street, Evansville, Ind., Figs. 1 and 2 showing a plan view and longitudinal vertical section of the device. The guide-bed is ribbed, and has pivoted spaced jaws sliding upon it, one jaw having an adjustable clamping block on its outer end and the opposite jaw upon the same end, with an opposing fixed clamping block, there being angular guide blocks adjustable upon the guide-bed, the vertical members of these blocks projecting upward between the opposing jaws, and having grooved contiguous



BACKER'S GUIDE FOR BAND-SAWS.

faces, with metal blocks screwed in the grooves. The jaws are adjustable endwise and laterally. The contiguous faces of the vertical members of the guide-blocks have dove-tail or wedge-shaped grooves in which wedge-blocks are inserted, the guide-blocks being preferably of iron or steel, and the wedge-blocks of brass. The latter blocks are adapted to form a guide for the heel or inner side of the saw, while wooden blocks constitute a guide for the outer or cutting edge. The device is adjusted to any width of saw through the screw shown in Fig. 1, and may be constructed and adapted for either a right or left handed mill.

A Telegraph Man Outwitted.

A few days ago several men from the electric light station dug a hole for an electric light pole opposite one of the finest residences in Malden, Mass. The owner of the residence, in the meantime, secured a man and told him to go up into the woods and dig the first tree he could find, and hurry back and place it where the hole for the electric light pole was. Before the men commenced to raise the electric light pole, the owner of the residence invited them to come into his cellar and take a drink, which they all did. There the owner detained them long enough to allow the man sent for the tree to come back and plant it. The others did not dare to remove the tree, so they put the pole into their wagon and drove off.

AN IMPROVED SASH FASTENER.

A simple locking device, whereby the upper and lower sash of a window may be simultaneously locked, irrespective of the position that the upper sash may occupy, is illustrated herewith, and has been patented by Mr. John H. Buettner, of No. 108 Pleasant Street, Cincinnati, Ohio. In our illustration, the dotted lines show the position occupied by the parts of the device when the sash is not locked. A plate is attached to the inner face of the window frame, just above the lower sash, there being a stop-pin near the upper edge of the plate, and another similar pin near its center.

BUETTNER'S SASH FASTENER.

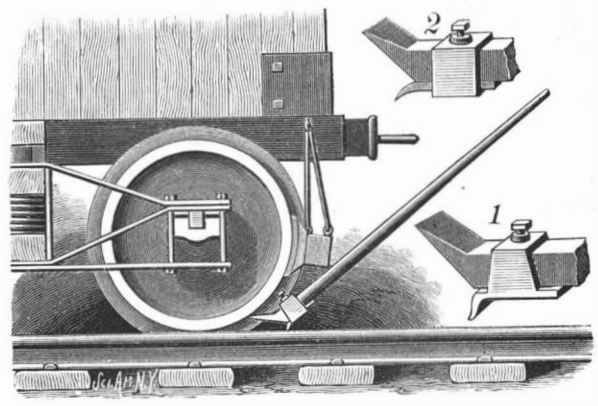
At each side of the center a locking arm is pivoted, the upper one curved downward and outward, and having an elastic bearing-block, preferably of rubber, secured in its horizontal extremity. The lower arm is slightly curved from its pivotal point, and has near its extremity a lug extending at right angles to the body. Each of the arms has a spur near its pivotal point, these spurs being adapted to engage each other when the upper arm is essentially at a right angle to the lower one. When the upper arm is pressed downward, so that its rubber bearing-block will press against the inner side of the upper sash, the spur on this arm bears against the spur on the lower arm, forcing the latter outward, when the other end of the lower arm is carried inward until it engages with the lower sash, upon the upper surface of which its lug has a positive bearing. The further the upper arm is carried downward, the tighter the lower arm binds against the lower sash.

Attraction of Gravitation.

At the recent Royal Society soiree Mr. C. V. Boys, F.R.S., contributed a portable apparatus for demonstrating the attraction of gravitation. The movable beam consists of two little masses of lead only one centimeter long, to which a galvanometer mirror is attached, and this system is suspended by one of Mr. Boys' filaments of quartz, by which the action exhibited is rendered possible. Around this can be moved a cylinder which carries two cylindrical lead weights each weighing a kilogramme, and the attractive influence of the heavier masses from the little movable beam was indicated by the movement of a spot of light through some fifty divisions of a scale fixed at the further end of the room. He forms filaments of quartz by means of a bow and arrow, the tail of the arrow being attached to a lump of molten quartz, the latter being drawn out into an excessively fine thread during the flight of the arrow, as if it had been a filament of melting sealing wax. A second experiment shown by Mr. Boys was designed to show the extraordinary insulating properties of quartz. In this experiment a pair of gold leaves forming an electroscope are supported on a little rod of quartz ¾ in. long, and although the surrounding atmosphere is kept saturated with aqueous vapor, the gold leaves retain their electrical charge for several hours, although, if glass were used instead of quartz, the charge would be dissipated in a few seconds. Moreover, the quartz may be dipped in water and replaced with its surface studded with globules of water, and it appears to insulate as well as before.

AN IMPROVED PINCH BAR.

The bar shown herewith, for moving or starting cars on railways, has been patented by Mr. Peter C. Forrester, of Wilkeson, Washington Ter. The bar proper is of the ordinary form, pointed with steel at its nose end,

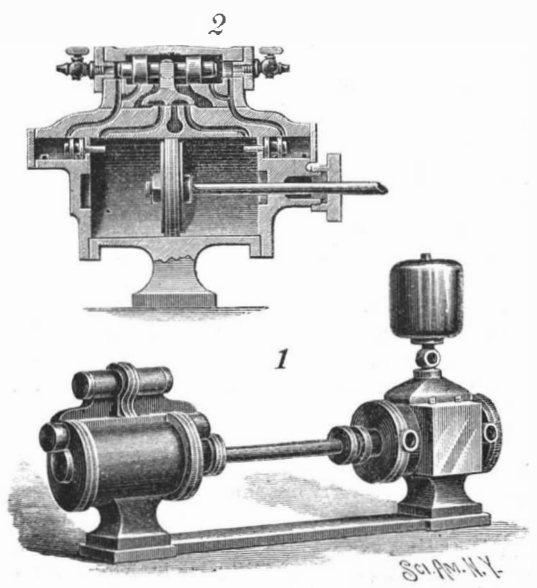


FORRESTER'S PINCH BAR.

where it bears upon the car wheel. A fulcrum piece or attachment, to bear on the rail, is made in the form of a sliding block, adapted to be readily slipped on or off the bar, as shown in Fig. 1. It is made with a sharp tooth on its under side, pointed with steel, to take a firm bite on the rail, and is fastened in the required position by a set screw, or may be so secured by a wedge or ferrule. Fig. 2 shows a modified form of the fulcrum piece or sliding block, in which the tooth, instead of being made integral with the sliding block, is made in a separate piece, and held in position by clamping it to the bar within the slotted body of the sliding block.

AN IMPROVED STEAM-ACTUATED VALVE.

The illustration herewith represents the valve arrangement of a steam pump in which the valve controlling the main piston is actuated by steam, and is in its turn controlled by other valves which have their action governed by main piston. This valve forms the subject of a patent issued to Mr. John W. Gheen, Astoria, Oregon. Fig. 1 represents the application of the valve to a pump complete, and Fig. 2 is a vertical longitudinal section of the steam cylinder end of the pump. The steam chest is constructed above the main valve to form a cylinder, to receive within it a piston attached to the valve, this piston having double heads and reduced opposite terminal extensions, arranged to work as pistons in and out of reduced cylindrical chambers at opposite ends of the body of the cylinder. Steam is admitted to the valve chest between these heads in the usual way. At opposite ends of the main cylinder are two small cylinders, connected intermediately of their length by passages with the reduced terminal chambers of the valve cylinder, these passages being again connected by branch passages with the enlarged portion of the valve cylinder, so that the heads of the piston portion of the valve may control them. The small cylinders in each end of the main cylinder have each a live steam port and an exhaust, and within them pistons work freely as independent valves, each having a stem normally projecting within the main cylinder. These valves are operated in one direction by the main piston coming in contact with their stems, and are moved by the pressure of steam on their backs in an opposite direction. This invention is not only applicable to direct-acting pumps, but also to direct-acting engines for other than pumping purposes.



GHEEN'S STEAM ACTUATED VALVE.

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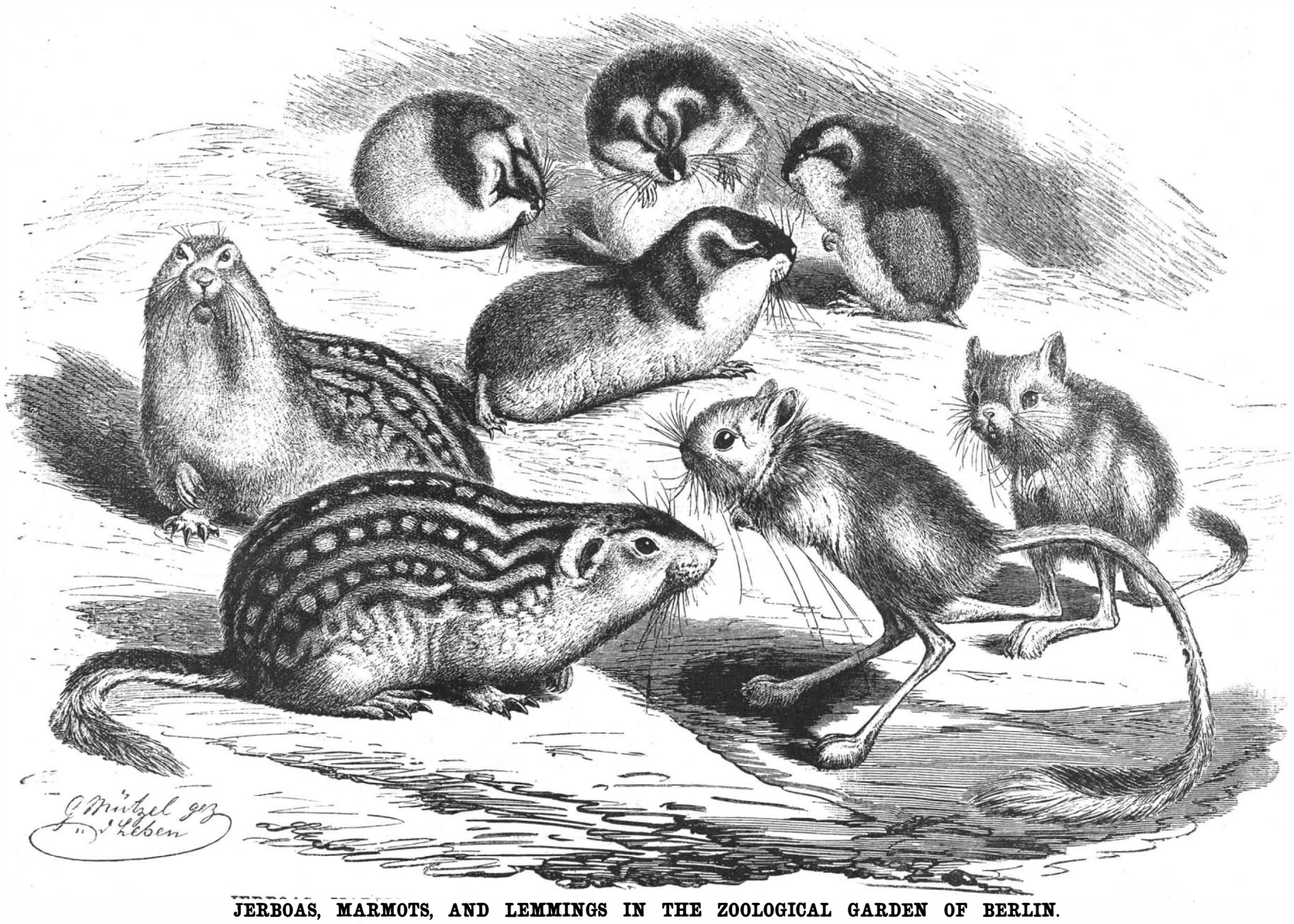
JERBOAS, MARMOTS, AND LEMMINGS IN THE ZOOLOGICAL GARDEN OF BERLIN.

The bird houses of the Berlin Zoological Garden always contain some small mammals, for which a better shelter cannot be found. Here they receive very little attention from the majority of the visitors, but this only adds to the interest of the real friend of animals. We refer to the three small rodents shown in the accompanying illustration, but seldom found in captivity.

The long-legged, thick-headed jerboa (*Dipus aegyptius*, Lichtst.) is a native of northern Africa. A true child of the desert, as Brehm calls them, they live in companies in places which their peculiar organization enables them to inhabit. In the construction of their extremely long hind legs, as well as in the unusual formation of the organs of the senses, especially the size of the eyes, by which the head is made broader than it is long, they bear an unmistakable resemblance to birds; and in fact, if the jerboa is to live in the vast desert, the surface of which is scarcely covered with the thin reed grass, he must rival the birds in activity and sharp-wittedness in order to obtain his poor food and to escape from his enemies. For this latter purpose the perfect sand color of his long, soft coat serves him well. This color is formed by a blue gray ground and the light tips of the hairs. The fore part of the arrow-like tail is dark brown and the rear part white. The fore legs are very short, and are generally held close to the body, being used in eating and in digging the caverns for the company, but not at all in traveling, which is accomplished by the use of the hind legs and the tail. When moving short distances the jerboa takes little tripping steps, but during flight it takes jumps that are colossal, comparatively speaking, and these follow each other so quickly and regularly that the animal seems to be flying over the ground.

The leopard marmot (*Spermophilus hoodi*, Richs.) is a North American representative of this species of rodent, which is spread over the northern hemisphere. They live gregariously in the plains of the United States, and are known by the pleasing and striking marking of their fur with stripes and spots, which will be better understood by a glance at our illustration than by even a long description. This pretty coat and their activity and intelligence hold the visitor who has the good fortune to see them a long time at their glass box, half filled with earth. The greater part of the day they spend in their burrow, where they carried a quantity of hay and food last fall. Since then they have been sleeping their winter sleep, from which it was difficult to waken them that they might serve as models for our illustration. Very little is as yet known about the life of these little creatures when wild, but judging from observations of their ways when in captivity, their habits must be about the same as those of the common marmot, excepting the differences which would be caused by the variations in the climatic conditions of their native haunts.

The lemming (*Myodes lemmus*, Pall.) is as well known by tradition as it is little known by actual sight, and is the little, thickset, and short-tailed field mouse which, by its migrations, has given rise to the numerous fables and to a certain mysterious light in which it appears in the natural histories. Of course we have long since learned to trace these migrations—which are not as numerous nor as regular as the old-time stories would lead us to believe—to their real source; that is, their rapid increase in a favorable climate and the consequent scarcity of food. Even without this mysterious nimbus, the lemming is a very interesting little creature, which, like the field mouse, bears the same relation to the common mouse as the hamster. Like the latter, the lemming is thickset, has a short tail, and its markings are more or less regular in color. The individuals differ in this respect, the ends of the black hairs sometimes being light and sometimes not. The lemming also resembles the hamster in character, showing the same courage, amounting to foolhardiness, for the little creature will leave his home to defend it by squealing and biting even when the contest is with men. But, while the hamster is disagreeable and even dangerous when angry, the much smaller lemming produces only amusement and merriment by his bursts of passion. Brehm's descriptions of the droll actions of these Liliputians when any one passes through their district, threatening the domestic peace of one or another by coming, voluntarily or involuntarily, too near their holes, are very entertaining. The Norwegian lemming lives on the high mountains of Scandinavia, in the region between the growth of trees and the perpetual snows. Still farther north, in Lapland, he lives in the swamps of the plains, for he knows how to use every dry spot. Other species of the genus are found, in Asia and North America, throughout the entire frigid zone. It is difficult to keep lemmings in captivity, and those under my care are the only ones I know of. Our picture is the first one drawn in Germany by a master hand from living subjects.—*Illustrirte Zeitung.*



JERBOAS, MARMOTS, AND LEMMINGS IN THE ZOOLOGICAL GARDEN OF BERLIN.

CHICAGO will probably have one of the finest libraries in the world in the course of a few years. Mr. W. L. Newberry, one of the earliest residents, left the sum of $250,000 for the purpose, and a temporary building has been used for some time. It is now intended to erect a magnificent edifice, capable of holding 300,000 volumes.

Tetanus Treated by Absolute Rest.

Prof. Renzi, of Naples, records several cases of tetanus successfully treated by absolute rest. The method advocated is as follows: The patient's ears are closed with wax, after which he is placed in a perfectly dark room far from any noise. He is made to understand that safety lies in perfect rest. The room is carpeted heavily in order to relieve the noise of stepping about. The nurse enters every quarter of an hour with a well shaded lantern, using more the sense of touch than sight to find the bed. Liquid food (milk, eggs in beef tea, and water) are carefully given, so that mastication is not necessary. Constipation is not interfered with. Mild doses of belladonna or secale are given to relieve pain. This treatment does not shorten the disease, but under it the paroxysms grow milder, and finally cease. Numerous physicians attest to the value of this treatment.—*Bulletin Med.*

Consumption of Ties.

Assuming the entire railroad system of the United States to be 160,000 miles, as appears from "Poor's Manual," with the addition of the lines in construction during the current year, and taking 2,640 ties per mile of track, we have in use at least 422,400,000 ties. This estimate, large though the total appears, is under the mark, as no railroad uses less than 2,640 ties per mile, and many of the roads with heavy traffic have 2,816, and in a few cases more.

The life of these ties varies according to their quality and the climatic conditions; but in the East, where only the best ties are employed, the average life is found to be about six years, while in the West, where poorer quality of timber often has to be accepted, and where dry rot and other disadvantages have to be contended with, the average life is from three to five years; so that even after allowing for a few exceptional cases in which ties may last ten years, the average life of ties all over the country cannot be counted as more than five years.

It follows, therefore, that the annual consumption must be about 84,500,000, which, with steady increase of railroad building, must soon exceed 100,000,000—a gigantic demand to be satisfied from our forests each year, when we consider the many other calls upon them, and the fact that at present virtually nothing is being done by the government or the people to replenish our source of supply.

The certain rise in the price of wooden ties, when these facts come to be fully appreciated by the lumbermen who control so large a part of the available timber area, will force the railroads to seek the best solution of the question in the adoption of a metal tie.—*Pacific Lumberman.*

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Screw Propellers.

The escape of her Majesty's ship Calliope from the harbor of Apia at Samoa, when the German and American squadrons had to succumb to the fury of the hurricane, was recently noticed in our columns, reference being made to the excellence of the engines with which the vessel is fitted, by means of which she was enabled to make headway against the storm. On this topic something more may yet be said, and the subject is one well deserving full consideration. Coupled with the engines there is the propeller, and although at first the allusion may excite an incredulous smile, yet the fact that the screw of the Calliope was made of manganese bronze will be found, after a little investigation, to be a circumstance that ought not to be disregarded.

We refer to the subject not merely for the sake of demonstrating the advantage which there is reason to believe the Calliope derived from the character of her propeller, but in order to deal with certain data, by which it would appear that a screw of this description really offers a substantial gain in the matter of speed. It is to be remembered that the Calliope made her way against the storm simply at the rate of half a knot per hour; of course her inherent speed was considerable, but the storm neutralized the whole of it, except this small balance left in the ship's favor. What may be termed the effective speed was very little, but that little was sufficient to save the ship. The Calliope may never encounter the like dilemma again, and it may rarely happen that an extra half knot per hour will rescue a ship from destruction. Yet this little half knot, continuously maintained, is not to be despised, especially on a long voyage. Or if the extra speed is not desired, a saving of fuel may be effected, representing in the aggregate a very appreciable sum of money.

Reasons are forthcoming why a screw propeller made of manganese bronze should give a better rate of speed than one of gun metal or steel or any other metal yet known. But, in the first place, we may fall back on ascertained facts. It may be readily conceded that a commercial body like the Peninsular and Oriental Steam Navigation Company would not enter upon an extensive adoption of manganese bronze for the screws of its steamships, unless there was some practical advantage to be gained by doing so. Eleven of its ships are thus equipped, and a striking example on this point was mentioned a year ago, before the Institution of Naval Architects, by Mr. G. W. Manuel, the company's superintendent engineer. The screw blades of the Ballarat, made of steel, had been exchanged for others made of manganese bronze. In this instance, although the gain in speed was only about a quarter of a knot per hour, the effect was seen in a saving of between eight and nine tons of coal per day, or a total of 715 tons on the voyage out and home between England and Australia. The saving in coal represented about half the first cost of the bronze blades. This comparison is the more valuable, owing to the fact that the diameter, pitch, and surface of the propellers were the same in both cases.

Another very striking instance is furnished by the Australia and Zealandia, two steamships engaged in the mail service between Australia and San Francisco. These ships, originally fitted with steel propellers, had manganese bronze blades of exactly the same surface and pitch substituted. The speed was then found to be increased nearly one knot per hour, and the passage was made in two days' less time. A very satisfactory pecuniary result has been secured with regard to these vessels, by the acquisition of postal premiums, the amount being such as to pay many times over for the cost of fitting the new propellers. Eight ships of the White Star line have propellers of manganese bronze, as well as two belonging to the Cunard Company. On the Inman line we have the City of New York and the City of Paris, the latter famous for her extraordinary speed just accomplished on her first voyage to America and back. The Pacific and Orient Steam Navigation Company has manganese bronze propellers for the Orizaba, the Oroya, and two other vessels of its line. The North German Lloyd Steamship Company has done the same with eight of its ships. One of these, the Lahn, of 8,000 indicated horse power, lately made a remarkably rapid voyage.

Some time ago the Scottish Oriental Steamship Company substituted manganese bronze propellers for others of iron and steel in four of its ships, the increased speed ranging from two-thirds of a knot to one knot per hour. The four other steamers belonging to this company were fitted with bronze blades when built. Other instances might be mentioned, but these will indicate the appreciation which steamship companies have entertained for this particular kind of bronze, and there is every prospect that the use of the metal for propellers will extend. Outside the circle of the mercantile marine, we have the example of the British Admiralty. The Colossus was fitted with twin screws of manganese bronze after a series of experiments on the strength of this material as compared with gun metal, the trials being made at the works of Messrs. Maudslay, Sons & Field, in the presence of the Admiralty inspector, with the result that the manganese bronze was found to possess just double the strength of gun metal. Consequently the adoption of the bronze effected a saving of from 20 to 25 per cent in the weight of the propeller. In addition to the Colossus and the Calliope, manganese bronze has been employed for the propellers of the Calypso, Rover, Rattlesnake, and Sandfly. The French government has adopted the same metal for the twin screws of the Tage, Cecille, Forbin, Surcouf, Troude, Lalande, and Cosmao. The Russian government has taken the same course with regard to the Amiral Kornilow and the Rhynda.

We may now say something as to the probable cause of the advantage given by manganese bronze when this metal is employed in the construction of screw propellers. A particular kind of manganese bronze is used for this purpose. There are five different qualities of the metal, that of which the propellers are made possessing great strength and toughness. We have already mentioned the proof of this in the trials made in the presence of the Admiralty inspector. The transverse strength of the metal is stated to be about equal to that of the best cast steel. Hence, as compared with gun metal, a great reduction can be effected in the thickness of the blades, which therefore become finer and sharper. There is also a peculiar smoothness of surface, producing a diminution of skin friction, especially important where high rates of speed are employed. A velocity of forty or fifty miles per hour in the extremities of the blades gives value to everything which reduces the unproductive resistance. The power thus saved is utilized in giving greater speed to the vessel. Steel castings for propeller blades are very rough, and are almost always out of true pitch, owing to the warping which they undergo in the annealing furnace; whereas the manganese bronze blades are almost mathematically true, as shown when tested by the pitchometer.

This metal has the advantage over steel of being more fluid when melted, thereby producing a finer casting. Freedom from pitting and corrosion preserves the blades for a long time in their original form, so that the life of a bronze blade may be reckoned as equal to that of the ship to which it is attached. So great is the saving of weight in the construction of a manganese bronze propeller, that the reduction in the outlay for raw material renders the price about equal to that of a propeller made of gun metal, although weight for weight the bronze is from 20 to 25 per cent dearer. There is also the recommendation that the manganese bronze propeller will fetch a good price as old metal. As compared with steel, manganese bronze is about three times dearer at the outset. But the pitting which so soon takes effect on steel greatly enhances the cost in the course of years, so that after the lapse of a certain period that which appeared the dearest proves to be the cheapest. Taken all in all, there is accordingly much to be said in favor of manganese bronze. In these days, when "commerce destroyers" are in vogue with foreign navies, and vessels to catch these "destroyers" are specially needed in the navy of England, it is well that we should not only know how to make powerful engines, but how to apply such power to the most efficient and enduring propeller. For this purpose we shall expect to find manganese bronze growing in favor as time goes on.—*The Engineer.*

Something New in Photo-lithographic Work.

BY W. T. WILKINSON.

The usual method of making photo-lithographic transfers is upon gelatine made sensitive with potassium bichromate. This is quite sensitive enough to day light or to electric light; but if transfers are required when neither day nor electric light is available, then bichromated gelatine is useless, and some other method is wanted. Try this. Make a print upon any of the ordinary bromide papers of commerce, using a good negative from a subject in line, by artificial light; and develop the image with alkaline pyro, then wash and place it upon the inking board; next, blot the water with a soft cloth, and dab all over with a sponge saturated with transfer ink, thinned with turpentine; let the turpentine evaporate, then take a glue roller, *i. e.*, a type printer's roller, and roll until the whites are quite clear of ink. Now soak the print in the pyro again for a few seconds, and expose it to the light. Finally, wash free from pyro and hang the print up to dry. When it is dry the print is ready for the transferer, who treats it the same as he would any other photo-lithographic transfer.

The only way to fail with this method is to over or under expose the print, or to use a bad negative. The negative must show perfectly clear lines. Some of the newer papers of commerce contain too little gelatine to succeed perfectly; therefore, it is best to make the paper at home. It is not a very complicated process, as the color of the image under the developer is not all-important. A good formula is:

Gelatine	800 grains.
Water	30 ounces.

When the gelatine is quite soft, melt it at 120° F., and add 320 grains of ammonium bromide. Stir it until it is dissolved, then add ten minims of hydrochloric acid and stir well.

In 10 ounces of water dissolve 450 grains of nitrate of silver, bringing this solution to the same temperature as the gelatine solution; now proceed to pour the silver solution into the gelatine in a very thin stream, stirring it vigorously all the time. Now strain it into a warm dish, and tilt the solution so that it is only along one edge of the dish. Having made a small roll of the paper, lay one edge of the roll upon the liquid, and as it curls take hold of it and lift it slowly up, when the paper will unroll itself and receive a nice even coat of emulsion. Hang it up to dry, and repeat until all the emulsion is used.

For half tone transfers, use the bromide and chloride of calcium with 200 grains extra of gelatine, drying the paper at as high a temperature as possible without melting the gelatine. Paper with this emulsion upon will be very hygroscopic, and must be kept very dry. Before use, always dry the paper, and warm again before developing, so as to encourage reticulation of the gelatine.

This paper is to be exposed under a half tone negative, developed and washed, then inked up as directed for the line transfers, followed by immersion in the developer, and subsequent exposure to light, washing, and drying. To transfer to stone, trim with a pair of long shears, then put it into the damping book until quite limp. Then sponge the back of the transfer with a solution of oxalic acid 1 part, water 100 parts. Take great care that none of this solution gets on the front of the transfer. Lay the sheet in position upon a cold, dry stone, and pull it through the press, with plenty of pressure, five or six times, without lifting the tympan. The paper can be lifted off, leaving the image in ink on the stone. Gum it in, and leave it for five or six hours before rolling up.—*Photo. News.*

Rubber Stamp Ink.

The usual rubber stamp inks are prepared with water soluble aniline colors and glycerine. A good formula, which we have tested practically, is given by Dieterich:

BLUE RUBBER STAMP INK.

Aniline blue, water sol., 1 B.	3 parts.
Distilled water	10 "
Pyroligneous acid	10 "
Alcohol	10 "
Glycerine	70 "

Mix them intimately by trituration in a mortar. [The blue should be well rubbed down with the water, and the glycerine gradually added. When solution is effected, the other ingredients are added.]

Other colors are produced by substituting for the blue any one of the following:

Methyl violet, 3 B	3 parts.
Diamond fuchsin I	2 "
Methyl green, yellowish	4 "
Vesuvin B (brown)	5 "
Nigrosin W (blue black)	4 "

If a bright red ink is required, 3 parts of eosin BBN are used, but the pyroligneous acid must be omitted, as this would destroy the eosin. Other aniline colors, when used for stamping ink, require to be acidulated. —*American Druggist.*

Improved Indices.

Burr's patent combination index, manufactured by the Burr Index Co., of Hartford, Conn., covers a long felt need in the way of improved indexes. We speak from experience, as we have had the Burr index in use in the SCIENTIFIC AMERICAN office for over two years past. Our first order was for an index for 10,000 names. The work proved so useful we soon ordered another of still larger capacity.

This index is extensively used by the United States and Canadian governments, leading railroads, banks, insurance companies, and representative firms in all parts of the country. The system is complete, the plan simple for general use, readily understood, and so arranged that any name can be found at once.

The indices are made with great care, from the best of material, calculated for constant and hard use: made of any size, ranging in capacity from 500 to 1,000,000 or more names, and the largest number of names can be handled with the utmost rapidity and convenience.

Wild Boars among Us.

According to the *American Field*, wild boars have become very numerous in the deep recesses of the Shawangunk Mountains, that border Orange and Sullivan Counties, N. Y. They are the genuine Black Forest wild boars of Europe, the descendants of nine formidable and ferocious boars and sows which Mr. Otto Plock, of New York, imported some few years ago for the purpose of annihilating the snakes and vermin that infested his estate near the Shawangunk Mountains. After the boars had eaten up all the snakes and vermin in the inclosure, they longed for more, and dug under the wire fencing and escaped to the mountains, where they have since bred and multiplied. They are so ferocious that the most daring hunter is said to hesitate before attacking them. They have immense heads, huge tusks and shoulders, and lank hind parts.

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THE NEW LONDON DOUBLE TRACK RAILROAD BRIDGE AND DRAW SPAN.

(*Continued from first page.*)

by the largest drawbridge in the world, and a saving for the traveler of no inconsiderable amount of time will have been effected.

The work now in progress involves not only the bridge proper, but some five miles of approaches. Mr. Alfred P. Boller has been appointed engineer in the service of the railroad, for the designing and superintendence of this work. The new line of railroad makes a detour in New London and reaches the shore at Winthrop's Point, about half a mile above the present ferry landing. The company in building the bridge was limited by conditions imposed by the U. S. authorities as to its position and span, which, together with the favorable disposition of the shores, caused this point to be selected. On the eastern side, after the shore line is passed, some very precipitous and rocky ground is encountered. The new line is carried through this region for about four miles before joining the main line. No saving in distance is effected by the change. The legal restrictions and nature of the ground made the change of route a necessity.

The Thames River is a tidal estuary about fourteen miles in length. Near its mouth is the town of New London, at its head is the town of Norwich, at which point the Niantic and Shetucket rivers enter it. The bridge is located at a narrow portion, where the inlet diminishes to 1,500 feet in width. On the west shore, the bank descends quite steeply to the river; on the east, the rise is gradual and the water grows shallow more slowly. Fortunately for the building operations, the current is a sluggish one, even in spring freshets, as a rule, not being very serious. The depth of water in the channel, which may be said to include over two-thirds of the width, varies from forty to sixty feet. The bottom is soft at the surface, but runs into a stiffer clay with sand and gravel as a greater depth is reached, and about 130 feet below the water level a hard bottom is reached. This bottom, by means of piling, is used to support and carry the bridge piers.

It is evident that the depth was too great to admit of pneumatic working, and the expense of dredging down and sinking a complete caisson to the solid ground seemed to prohibit this mode of construction. A novel method was therefore adopted. An open caisson or double-walled crib was built and sunk into a hole formed by dredging to the depth of 18 feet below the natural bottom. The center area of this crib was divided into pockets, and the whole was driven full of piling that ran down to hard bottom. The piles were then sawed off; for the center pier, 60 feet below the surface of the water; for the other piers, 42 and 50 feet respectively. An open top caisson was now built with a solid bottom, and with temporary sides carried up above its floor. It was fastened with composition spikes. The bottom was of 12 by 12 inch hemlock, and the sides and deck were cased in double courses of planking impregnated with 14 lb. of coal tar creosote to the cubic foot of timber. It was floated to its position over the piling and crib work. The masonry for the piers was laid upon the bottom of this floating caisson, which gradually sank under the weight until it reached the piling. The masonry was then carried up until above the surface, when the temporary sides were removed, and the masonry pier stood alone in the center of the stream.

The cribs, it will be remembered, were sunk into dredged holes. The center was pretty well filled with piling, but as it stood unbraced within the crib, sand was dumped upon it before the caisson was lowered. This filled every interstice, and the piling is now held as firm and immovable at the top as at the bottom.

The three river piers were all established in general by this method. As the center pier has to sustain alone and unaided the great draw span, it was thought best to submit it to an unusual consolidating process and incidental test. It was accordingly loaded with 2,700 tons of pig iron. This compressed all the timber portion strongly together and forced the caisson floor down upon the piling. Thus any piles that projected a few inches above the rest were forced into the wooden caisson bottom, so as to give all an equal bearing. To give some idea of the amount of metal thus deposited upon the pier, the operation of loading the pier is illustrated in one of the cuts.

The superstructure is built entirely of steel. For most of the members open hearth steel is used. For some compression members Bessemer steel is admitted. The end spans are covered by deck trusses on the triangular system, twenty-four feet deep. These are of 150 feet span each. Next come the two long spans, one on each side of the draw, and of 310 feet span each. These are through trusses, the floor or deck lying in the plane of the lower chord. In the center they are 45 feet deep, at each end 25 feet. The draw span is 502 feet long. At the center it is 75 feet deep, and runs down at each end to 25 feet. The curve described by each division of the truss is a parabola, so that the contour of the cable of a suspension bridge, when the bridge is equally loaded over its entire length, is to a certain extent exhibited. All the span lengths are given from center to center of piers.

The central draw span affords two clear openings of 225 feet width each. The great width was exacted by the Federal government, who possess a naval station above the bridge, and who desired as little obstruction as possible to be placed in the channel leading thereto. Another feature was designed to accelerate the rapidity of operation of the draw. The design provided for swinging the bridge through the entire circle. Thus, when opened for the passage of a vessel, it could be kept rotating, following the motions of the vessel as she passed through and closing without reversal.

The machinery for moving the draw is placed upon the central pier, below the bridge span. It comprises an engine with two oscillating cylinders, 7 by 10 inches, running at 200 revolutions per miuute. This motor operates through differential gear, and is thrown into and out of engagement by friction clutches. The turntable proper is of steel, with a heavy rim, which bears upon fifty-eight cast steel wheels. These are coned and bear upon accurately matched steel tracks. The drum is 5 feet deep, and is supported upon eight equidistant points upon the table.

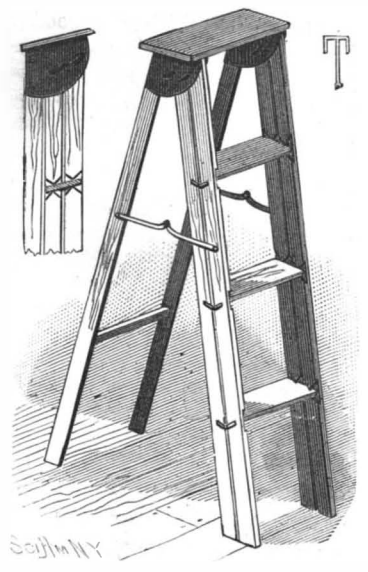
Under the pivot pier there are 640 piles, distributed over an area of about 5,000 square feet. The rest piers are carried upon 368 piles, each distributed over nearly 4,000 square feet. The draw span and table alone weigh 1,200 tons, and, in connection with the stone and caisson floor, brings a weight of eight to ten tons to bear upon each pile.

The superstructure is proportioned and calculated to bear a live load of 3,000 pounds to the lineal foot of track, with the superadded weight of two consolidated locomotive engines. It is two-tracked for its entire length.

The chief engineer, Mr. Alfred P. Boller, of this city, was seconded in carrying out the work by Colonel J. Albert Monroe, resident engineer. Mr. Alexander McGaw, of Philadelphia, was contractor for the masonry, and Mr. Warren Roosevelt for the piling and and timber work. The trusses and metallic superstructure were supplied by the Union Bridge Co., of New York and Buffalo.

AN IMPROVED FOLDING STEP-LADDER.

The accompanying illustration represents a folding step-ladder which may be used as an ordinary ladder, or automatically converted into a folding step-ladder, one of the small views showing a vertical section of the upper portion of the ladder in folded position for use as a folding step-ladder, and the other representing one of the step hinges. This invention has been patented by Mr. John A. Neill, of No. 214 L Street, East Portland, Oregon. The ladder is formed with two pairs of double uprights, and folding supports or legs, the latter being secured to the top by plates bolted thereto and secured to the under side of the top. The upper ends of the double uprights project and move between the plates, and are connected thereto by screws or pins riding in curved slots in the plates. The upper ends of the double uprights are formed with inclined surfaces which fit against the under side of the top when the ladder is unfolded, and are connected together on each side by the bent cross portion of the hinge, the main portion of which extends between the uprights and beneath the steps, serving as a brace therefor. The legs and double uprights are held in unfolded position by means of folding brace arms.



NEILL'S STEP-LADDER.

The Electrical Census Machine.

This system of machines may be described as follows: The census collector will call with his printed blank, and answers to questions will be written in the usual way. These sheets will then be placed before a person who operates a machine which may be likened to a type writer, except, instead of the usual ink mark on paper, small round holes are punched in a card. The cards, one for each person, are about 6½ inches in length by 3 inches in width, and the particular position of a hole in a card indicates an answer to some of the questions in the printed blank. As many as 250 items of information can be punched out upon a card, although no one card would ever have more than one-tenth part of the whole number, as, for example, no one person can be classed as both white and black, American and foreign born, and if foreign born he can only come from one country.

These cards when punched are placed one at a time in a sort of press, and a lever operated by one hand is brought down, when a series of pins are brought against the card. Whenever a hole has been punched in a card the corresponding pin passes through into a mercury cup beneath, completing an electric circuit. These circuits, one for every hole, pass out to a large number of counters which operate electrically, and which add upon their dials all items of the same kind upon the same dials; as, for instance, all white men upon a dial marked white males; all business or professional people upon dials which indicate their particular business or profession. The cards, as they leave the press, are all sorted by means of an electrical sorting device, whereby they may be separated into groups or States of the Union.

It will thus be seen that the machines are much more reliable than the most accurate human agency, and that one machine will do the work of a large number of clerks. The next census of this country will be taken with these machines, and two will be sent to New York soon for the 1890 census taking.

Treatment of Foreign Bodies in the Stomach.

A method of treatment for foreign bodies in the stomach, which appears to be generally known and practiced with almost uniform success in both England and the Continent, consists in the administration simply of large amounts of potatoes, to which the diet should be restricted. It is stated by Professor Cameron, of Glasgow, that this plan, which, so far as we know, is almost unknown in this country, originated with the London pickpockets, whose custom it is to immediately swallow small articles of jewelry acquired in the pursuit of their profession, and then depend on their recovery through the evacuation which follows the abundant use of the potato diet. Several cases are on record where this method has proved eminently successful. Thus, Dr. Salzer (*Deutsche Medizinal Zeitung* for January 24, 1889) reports the case of a child who had swallowed a brass weight of three hundred grains in September, 1887, and in whom the physician was on the point of performing gastrotomy. According to Dr. Salzer's advice the child was put in bed, kept on his right side, so as to facilitate the passage through the pylorus, and then fed with as much potato, prepared in different methods to stimulate the appetite, as he could be persuaded to take. In five days the foreign body was evacuated in the fæces. He also refers to a case of a patient who had swallowed a set of artificial teeth, and another who had swallowed a breast pin one and a half inches in diameter, in both of which cases the foreign bodies were removed without difficulty.

At the meeting of the Society of Physicians in Vienna, at which the above cases were reported, the discussion which they stimulated led to the report of several other cases, one especially, by Hochenegg, which is especially remarkable in that it dealt with the case of a young carpenter, who, in 1884, swallowed a long nail, which was removed by gastrotomy. Two years later the patient was so unfortunate as to swallow a second nail similar in all respects to the first. The potato cure was employed, and the nail was secured after nine days. In the *Deutsche Medizinal Zeitung* for March 11, 1889, Dr. Deichmuller refers to a case of a young girl, ten years of age, who had accidentally swallowed a pin. Pain was complained of under the breastbone, and Dr. Deichmuller, acting on the suggestion acquired through the report of the above cases, restricted the patient to the potato diet. Very shortly afterward the pain disappeared from the chest and was felt in the stomach. Six days later it appeared in the right inguinal region; two days subsequently, having increased in severity, it was felt in the left inguinal region, while in the evening of this day the foreign body was evacuated with the fæces.

It is hardly necessary for us to call attention to the principles upon which this method is based. Potatoes, as is well known, are composed of nearly twenty per cent. of carbohydrates, eighty per cent. of the solids being starch and cellulose. On account of this large amount of carbohydrate, a great portion will resist the action of the digestive juices. The cellulose and other carbohydrates increasing greatly in volume from imbibition with water, lead to an accumulation of an immense amount of indigestible residue; consequently the intestinal tube is, throughout the entire time of the administration of this food, filled with large masses of non-absorbable matter. The folds of the intestine become obliterated, and fixation of the foreign body in the intestinal tube is thus avoided. It seems that from five to nine days, or even longer, are required for the evacuation of the foreign body, and in every case which does not seem desperate, a trial of this simple plan of treatment should precede resort to gastrotomy. In fact, at the recent meeting of the Vienna Medical College, Prof. Billroth said that since the introduction of this procedure, gastrotomy for foreign bodies should become an obsolete operation.—*Therapeutic Gazette.*

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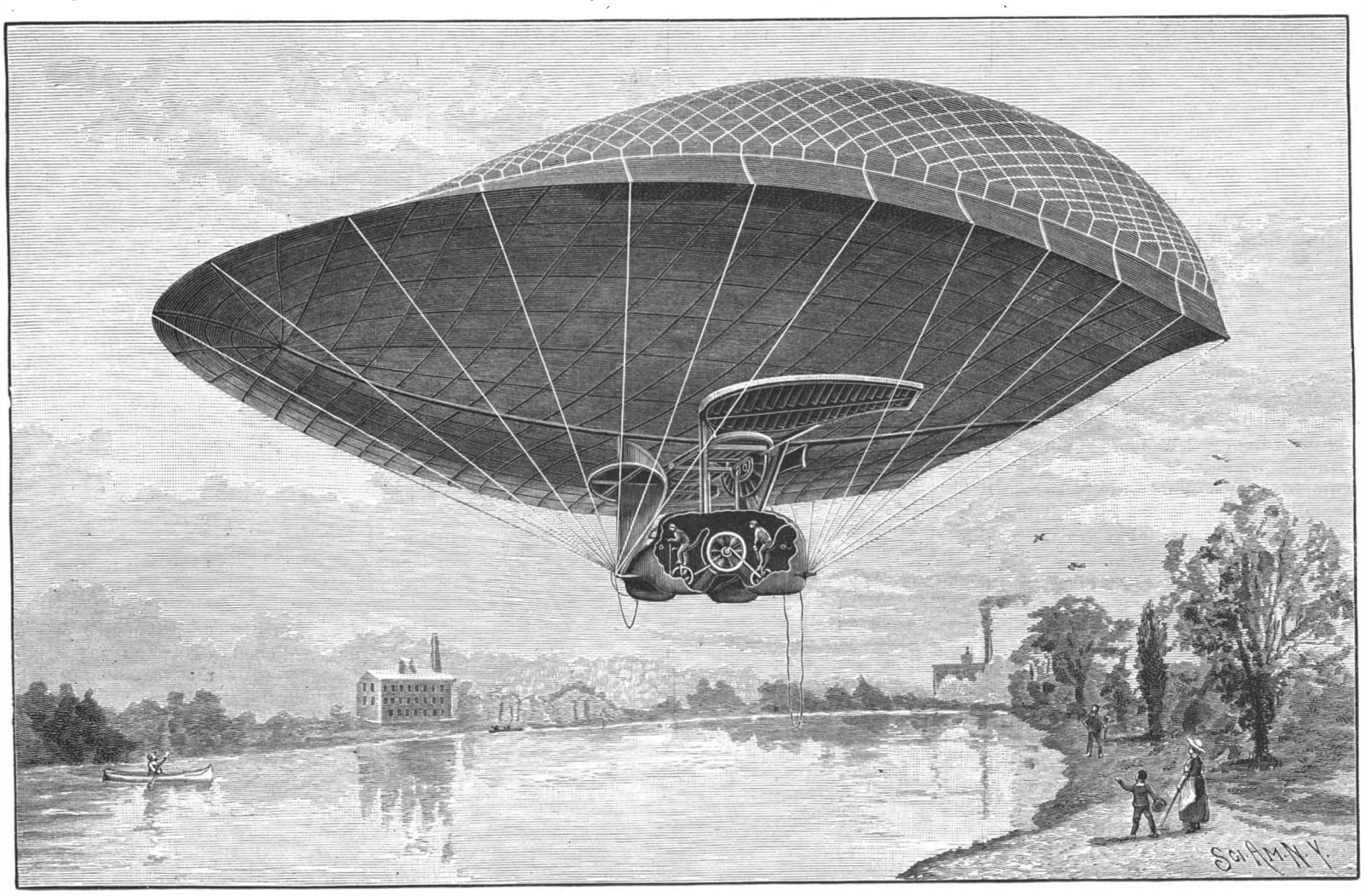
AN IMPROVED AIR SHIP.

An air ship designed to be completely under the control of the operator, and to be easily steered and propelled in any direction, with, on, or against the wind, is shown in the accompanying illustration, and forms the subject of a patent issued to Mr. Herman A. J. Rieckert, of No. 124 Rivington Street, New York City. The most prominent feature of the construction is a balloon made in three compartments, the lower one stiffened by a framework and supporting the second compartment, on which is secured the third compartment, exposed to the action of the wind, and with its edges attached to the framework. A closed basket, the interior of which is partly shown, is supported on the under side of the balloon, and contains a motive power, preferably in bicycle form, for operating sidewise flapping wings and central wings. A suction wheel is mounted to rotate above the basket at its rear from the motive power located in the basket, communicated through a friction wheel, which can be readily thrown into and out of contact with the suction wheel, while a propeller wheel is secured on the shaft of the friction wheel, to be operated thereby. The steering device, located in front of the basket, consists of a vertical wing mounted to swing, and a disk wing pivoted on the vertical wing, ropes extending into the basket for operating the wings. Connected with the balloon is a filling receptacle, communicating with its three compartments, this receptacle having an inlet pipe adapted to be connected with the gas supply, while three outlet pipes lead to the compartments, and apertured slides held in the receptacle control the inlet of gas and the outlet of air. In the basket are wheels mounted to be rotated by crank arms and treadles, an eccentric being secured on the shaft of the central fly wheel, a rod extending upward from which is connected with a lever, by which the suction wheel is operated, while the flapping side and central wings are operated from the rod. Combined with the main flywheel is a starting device, consisting of a friction wheel adapted to engage the periphery of the flywheel, while the shaft on which the friction wheel is secured carries a propeller wheel, its shaft having a pivotal bearing, with the free end of which a lever is pivotally connected, to throw the bearing up or down to alternately engage or disengage the friction wheel.

The different compartments of the balloon are covered with the usual material, preferably silk, and the top compartment is made to shift and assume different positions according to the direction and strength of the wind, our illustration showing its position at a normal pressure of the wind or at a normal velocity of the air ship. A sidewise pressure of the wind causes the top compartment to shift to the right or left, while the central compartment is almost stationary, shifting very little. On the under side of the lowest compartment is a transverse offset directly above the propeller wheel, the offset causing the air thrown out by the propeller wheel to exert a pressure against the front part of the lower compartment, so that the balloon will rise more easily. The inner wings are rectangular in shape, while the outer wings are placed in an inclined position, and have an outer frame and a central partition, between which and the sides of the frame are slats, on which are secured strips of canvas. These strips are bag shaped, the outer ends of each extending under the next following slat, so that when the wings move upward the bag parts of the canvas strips are opened downward, and when the wings move downward the bag parts are pressed up against the slats, whereby the wings will operate with their full power on the air. The central wings also have similar slats and canvas, and the arrangement is such that when the outer wings move upward the inner ones move downward, and *vice versa*. The balloon is also provided with the usual device for letting out gas in case a rapid descent is desirable, and it is designed that boats shall be secured to the bottom of the basket to sustain the entire device above water should it descend on a lake or ocean.



AN AIR SHIP WITH BALLOON DESIGNED TO BE READILY PROPELLED IN ANY DIRECTION.

Chance for Inventive Genius.

The State Grange of Illinois, through its executive committee, headquarters at Joliet, offers $10,000 to be paid to any one who will invent a machine or device to attach to reapers that will bind wheat and oats with straw.

Said device may work and twist its straw direct from the reaper, or it may be a separate machine that will twist the straw and wind on large spools that may be rereeled on smaller spools by the farmer and set in place in the reaper when wanted. Said money to be paid as soon as the device is proved to be a success. Should more than one person claim the above $10,000 on his invention, the committee reserve the right to choose the one that to them seems most practical. The said patent to be issued for the use and benefit of the Illinois State Grange and legally transferred by the said patentee. This offer holds good until July 8, 1889, and is signed by the following officers of the Grange:

J. M. THOMPSON,
Master Illinois State Grange, Joliet, Ill.
J. R. SHAVER, Ottawa,
GEORGE R. TATE, Smithton,
J. H. VANARSDALE, Peoria,
Executive Committee.

Growth of the Child's Mind.

In the last volume of the "Education Series," on "The Development of the Intellect," Mr. H. W. Brown has presented a conspectus of the observations of Professor Preyer on the mind of the child. This conspectus shows chronologically the gradual development of the senses, intellect, and will of the growing child, and presents in a condensed form the result of a great number of careful observations. Many of these results are already well known, but the presentation of them in a systematic and complete way has not heretofore been done.

It is recorded that sensibility to light, touch, temperature, smell, and taste are present on the first day of infant life. Hearing, therefore, is the only special sense which is not active at this time. The child hears by the third or fourth day. Taste and smell are senses at first most active, but they are not differentiated. General organic sensations of well-being or discomfort are felt from the first; but pain and pleasure, as mental states, are not noted till at or near the second month.

The first sign of speech in the shape of utterance of consonant sounds is heard in the latter part of the second month; these consonants being generally "m," "r," "g," or "t." All the movements of the eyes become co-ordinate by the fourth month; and by this time the child begins to have the "feeling of self," *i. e.*, he looks at his own hands, and looks at himself in the mirror. The study of the child's mind during the first year shows conclusively that ideas develop and reasoning processes occur before there is any knowledge of words or of language; though it may be assumed that the child thinks in symbols, visual or auditory, which are clumsy equivalents for words. By the end of the year the child begins to express itself by sounds, *i. e.*, speech begins. The development of this speech capacity is, according to Preyer, in accordance with the development of the intellectual powers. By the end of the second year the child's power of speech is practically acquired.

Professor Preyer's most striking and important conclusion, in his own opinion, is that the normal infant can form concepts and perform logical operations without the aid of words, or gestures, or symbols of any kind. He also shows what was known before, that the infant understands spoken language before he can produce the sounds he hears; and finally that the child, before he begins to speak, forms all the sounds that occur in his future speech. Professor Preyer thinks that by his observations he "has bridged over the only great gulf between the child and the brute animal."

The learned professor does not believe in stimulating the infant imagination by fairy stories or religious myths; but he believes in "Æsop's Fables," and has his son repeat one to him every morning. Such are some of the advantages of being the son of a physiologist.—*Medical Record.*

Tubercular Meningitis.

An interesting note is taken from a paper by Dr. Skeer, of Chicago, on the diagnosis of tubercular meningitis. The symptom is "a small circle which forms in the iris near to and completely surrounding the pupillary margin. At first it is very indistinct, and resembles a wreath of white clouds, the edge of which extends at first to the free border of the iris. In from twelve to thirty-six hours the whole margin of the iris will be involved, having become of a yellowish or whitish brown color, and appearing irregular, thickened, and somewhat granulated." Dr. Skeer considers that when in a case of cerebral meningitis the wreaths of white clouds appear in the iris, the question of diagnosis is settled beyond a doubt.

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A SIREN FOR MEASURING VELOCITIES.

BY GEO. M. HOPKINS.

In this instrument advantage is taken of the well known fact that for every tone a resonator may be provided that will respond to and re-enforce the vibrations producing that tone. The length of a closed resonant tube is one-fourth that of the sound wave to which it responds. The length of an open resonant tube is one-half

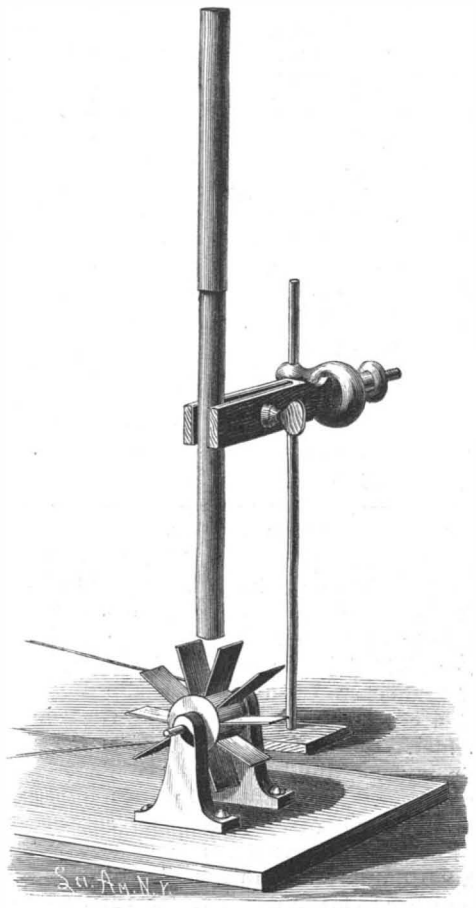

Fig. 1.—DETERMINING SPEED BY RESONANCE.

that of the sound wave to which it responds. It is obvious that a telescopic tube may be adjusted to respond to different pitches. Knowing the number of vibrations required per second to produce a certain pitch, it is comparatively an easy matter to determine the rate of any series of regular air vibrations by adjusting the tube to such a length as to cause it to respond to the vibrations.

In Fig. 1 is shown a resonant tube supported over a small fan wheel. The fan has ten blades, so that during one revolution it sends ten puffs of air up the tube. By gradually increasing the velocity of the fan a speed will be reached at which the tube yields a low but distinct musical tone. If, for example, this tone corresponds to middle *c*, it is known that 261 puffs of air are made in the tube, and that since there are ten blades to the fans, the number of revolutions of the fan shaft must be $\frac{261}{10} = 26{\cdot}1$ per second, or 1,566 revolutions per minute.

In Fig. 2 is illustrated a siren constructed on this principle. The parts of this instrument are shown in detail in Fig. 3. It consists of a circular casing containing a rotary fan which draws in air at the center and discharges it through an opening in the top of the casing. The blades of the fan are arranged radially upon opposite sides of the disk, and the fan is encircled by a perforated rim, which fits the circular casing and acts as a valve in controlling the escape of air. The perforations of the rim correspond in number and position with the fan blades.

The discharge of a socket for receiving a resonator. The resonator shown in Fig. 2 consists of a pair of tubes made to slide telescopically one within the other, the inner one being graduated to indicate the different lengths required for different pitches, and consequently for different speeds. As the fan revolves, the air drawn in through the holes at the center of the casing is thrown outward by centrifugal force, thus maintaining a pressure of air at the periphery of the fan. The holes in the rim of the fan allow the air to escape in regular puffs, the frequency of which depends upon the velocity of the fan. These puffs produce sounds varying in pitch and intensity with the speed of the fan, and the resonating tube re-enforces the particular note to which it is tuned, so that when a speed is reached corresponding with the adjustment of the tube, the fact is known by the superior strength of that particular note. Any change of speed may be detected by the lessening of the intensity of the sound and the change of pitch.

The siren is shown in Fig. 4 in connection with mechanism for driving it by hand. It is provided with a revolution counter and with a trumpet-shaped resonator. It is designed to be used in the same manner as the siren of Cagniard Latour, and, like that instrument, yields sounds under water.

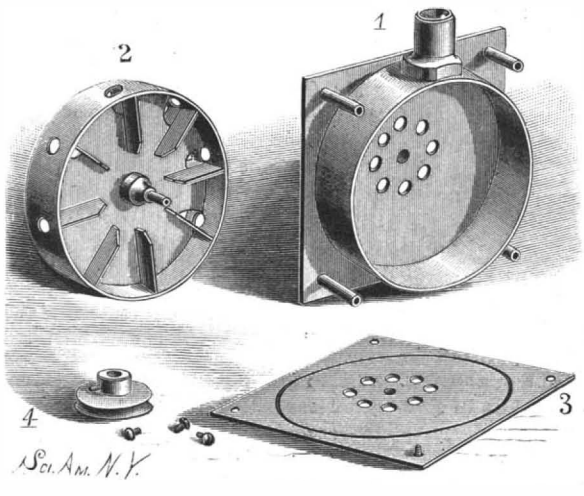

Fig. 3.—DETAILS OF THE SIREN.

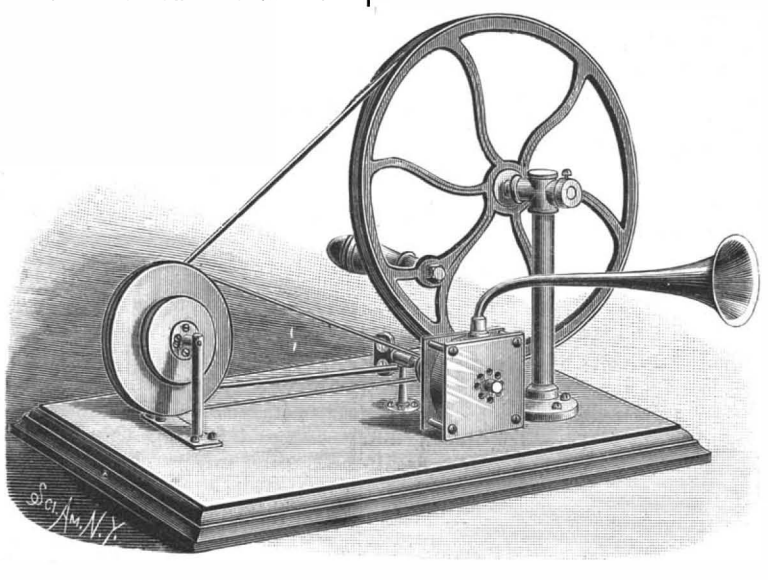

Fig. 4.—CENTRIFUGAL SIREN.

Utility of Hobbies.

Said a gentleman who had seen much of human life and was himself an enthusiastic student at threescore years: "No man in this world can be happy without a hobby."

With this as a text, another scholarly and amiable hobby rider said, as an introduction to a lecture upon his favorite study: "Indeed, for diverting our minds from the little crosses which we all have to bear, there is no earthly solace so healing as a subject in which we are intensely interested — something to which the thoughts may at any moment recur when weary of the suggestions we would escape.

"When, in addition to being an innocent diversion, ours is a useful study, we and our fellow-mortals are alike gainers. The person who passes through life without being an enthusiastic student of something loses more than he can appreciate.

"I emphasize the something, because nothing but natural selection can decide what ought to be each person's field of work. Nature is generous; the field is the world. With one it may be rocks or ferns, with another mosses or oaks; or leaving untamed nature for applied science, it may be the steam engine or the telescope, the field of language or the human form. No person has a right to say: 'My study is important, and yours is useless.' Each man's hobby is really for him the most valuable addition he can make to his own happiness, and the most precious contribution on his part to the sum total of human felicity and general knowledge."—*Universal Tinker.*

What are the Thoughts of the Dying?

In the Société de Biologie, Feré affirmed that a dying person in his last moments thinks of the chief events of his life. Persons resuscitated from drowning, epileptics with grave attacks, persons dying and already unconscious, but momentarily brought back to consciousness by ether injections to utter their last thoughts, all acknowledge that their last thoughts revert to momentous events of their life. Such an ether injection revives once more the normal disposition of cerebral activity, already nearly extinguished, and it might be possible at this moment to learn of certain important events of the past life. Brown-Sequard mentions the remarkable fact that persons who, in consequence of grave cerebral affections, have been paralyzed for years, get back at once when dying their sensibility, mobility, and intelligence. All such facts clearly show that at the moment of dissolution important changes take place, reacting upon the composition of the blood and the functions of the organs.—*Wien. Med. Zeitung.*

Japanese Gold Thread.

The above article, used in finer embroidery on account of its elegant luster, consists of a core of silk or of wool and a spiral envelope of thin gilded paper. The strip of paper is only two-fiftieths to three-fiftieths of an inch wide, and therefore must be wound with the greatest care. The thread thus wound is saturated gold thread, these threads possess the advantage of greater flexibility and finer luster. In this they equal the beautiful gold thread of the middle ages, whose manufacture for a long time was a lost art, and was recently discovered by microscopic investigation.—*D. Wollen-Gew.*

The Marriage of the Emperor of China.

The marriage of the Emperor of China took place at Pekin on February 25. The ceremonies enjoined by precedent appear to have been strictly followed. On the 25th the marriage procession started from the palace at two o'clock in the afternoon, and wound its way by circuitous streets to the residence of the bride. The mouths of the streets and lanes in the line of the procession were barricaded with double rows of high matting, the streets had recently been repaired, and were covered with yellow earth, and the houses along the route were festooned with red silk. Officials and Manchu bannermen, in their robes of office, lined both sides of the streets. The presents to the bride had previously been sent to her house. The procession was headed by four horsemen as heralds, followed at a short distance by a large cavalcade of horsemen led by the two imperial commissioners appointed to escort the bride; then followed nine pairs of white ponies with yellow trappings, two deep, led by men, next two large yellow satin sedan chairs, with eight bearers. These were followed by a huge crowd of bannermen in large red flowered robes, carrying lanterns, with the character "felicity" painted on them; then came halberdiers with large, round yellow silk fans or screens and two closed silk umbrellas. Last of all came the phenix chair in yellow satin for the bride, carried by sixteen bearers, succeeded by groups of horsemen. At two o'clock the following morning the procession returned to the palace, carrying the bride and the two young concubines. The Empress is said to be twenty-four years of age, the Emperor being only eighteen, and the concubines, who are two sisters, twelve and fourteen, respectively. The streets were lighted with fixed lamps, and the numerous bearers carried lanterns. There was no music. This is only the third time during the present dynasty that the marriage of the Emperor has taken place while he was on the throne. A week later on March 4, the Empress Dowager officially handed over the reins of power to the Emperor.

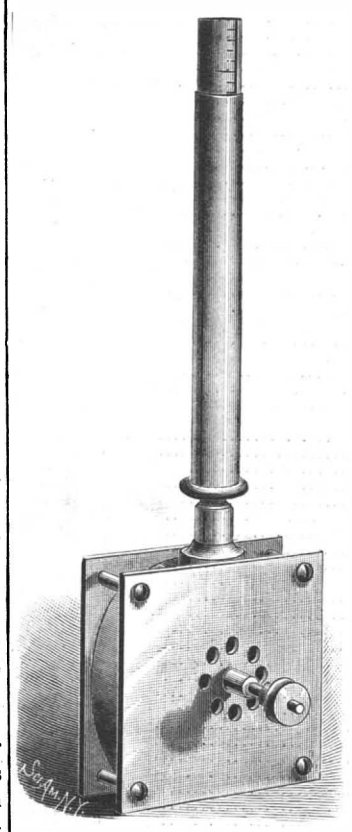

Fig. 2.—SIREN FOR MEASURING VELOCITIES.

Removal of Tattoo Marks.

The following method is recommended by M. Variot in the *Revue Scientifique:* The skin is first covered with a concentrated solution of tannin, and retattooed with this in the parts to be cleared. Then an ordinary nitrate of silver crayon is rubbed over these parts, which become black by formation of tannate of silver in the superficial layer of the dermis. Tannin powder is sprinkled on the surface several times a day for some days to dry it. A dark crust forms, which loses color in three or four days, and, in a fortnight or so, comes away, leaving a reddish scar, free of tattoo marks, and, in a few months, little noticeable. It is well to do the work in patches about the size of a five franc piece at a time. The person can then go on with his usual occupation.

SEVENTEEN year old locusts are due in New Jersey this summer, and Professor John B. Smith, the entomologist of the State Scientific School at Rutgers College, New Brunswick, is making arrangements to secure a complete record of their coming and going and of their actions while here, their numbers, size, etc. There is no such record now, it is said.

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The Paris Exhibition—Table of Congresses.

Subject of Congress.	Date.	Name and Address of President.
1. Accidents to workmen	September 9 to 14	M. Linder, 38, Rue de Luxembourg, Paris.
2. Advanced teaching	August 5 to 10	M. Gréard, The Sorbonne, Paris.
3. Aeronautics	July 31 to August 3	M. Janssen, Observatoire de Meudon, Seine-et-Oise.
4. Agriculture	July 3 to 31	M. Méline, Palais Bourbon, Paris.
5. Alcoholism	July 29 to 31	M. Bergeron, 157, Boulevard Haussmann, Paris.
6. Applied mechanics	September 16 to 21	M. Philips, 17, Rue des Marignan, Paris.
7. Architecture	June 19 to 22	M. Bailly, 19, Boulevard Bonne-Nouvelle, Paris.
8. Artistic proprietary rights	July 25 to 31	M. Meissonier, 131, Boulevard Malesherbes, Paris.
9. Assistance publique	July 28 to August 4	Dr. Roussel, 64, Rue des Mathurins, Paris.
10. Baking	June 28 to July 2	M. Cornet, 34, Rue de Rochechouart, Paris.
11. Bibliography of mathematical science	July 16 to 26	M. Poincaré, 63, Rue Claude Bernhard, Paris.
12. Care of the blind	August 5 to 8	M. Marten, 56, Boulevard des Invalides, Paris.
13. Celestial photography		
14. Cheap dwellings	June 26 to 28	M. Siegfried, 6, Rond-Point de Champs Elysées, Paris.
15. Chemistry	July 29 to August 3	
16. Chronometry	September 2 to 9	M. de Jonquières, 2, Avenue Bugeaud, Paris.
17. Colonies	....	M. Barbey, 22, Rue du Regard, Paris.
18. Commerce and industry	September 22 to 28	M. Poirrier, 105, Rue Lafayette, Paris.
19. Co-operative stores	September 8 to 12	M. Clavel, 2, Rue de Bourgogne, Paris.
20. Criminal anthropology	August 10 to 17	M. Brouardel, Ecole de Médicine, Paris.
21. Dentistry	September 1 to 7	Dr. David, 180, Boulevard St. Germain, Paris.
22. Dermatology and syphilography	August 5 to 10	Dr. Hardy, 5, Boulevard Malesherbes, Paris.
23. Electricity	August 24 to 31	M. Mascart, 176, Rue de l'Université, Paris.
24. Ethnography	....	M. Oppert, 2 Rue de Sfax, Paris.
25. Female work	...	
26. Fire departments	August 27 and 28	M. Wolff, 18, Avenue Bosquet, Paris.
27. Geography	August 6 to 12	M. de Bizemont, 184, Boulevard St. Germain, Paris.
28. Homeopathy	August 21 to 23	Dr. L. Simon, 5, Rue de la Tour des Dames, Paris.
29. Horticulture	August 16 to 21	M. Hardy, 4, Rue du Potager, Versailles.
30. Hydrology and climatology	October 3 to 10	M. Renon, Observatory du Parc, St. Maur, Seine.
31. Industrial proprietary rights	August 3	M. Tesserenc de Bort, 82, Avenue Marceau, Paris.
32. Legal medical science	....	Dr. Brouardel, Ecole de Médicine, Paris.
33. Literary societies	June 17 to 27	M. J. Simon, 10, Place de la Madelaine, Paris.
34. Marine work	October 7	M. Bernard, 43, Avenue du Trocadero, Paris.
35. Mental medical science	August 5 to 10	Dr. Falret, 114, Rue du Bac, Paris.
36. Meteorology	September 19 to 25	M. Renon, Observatory de St. Maur, Seine.
37. Methods of construction	September 9 to 14	M. Eiffel, 60, Rue Prony, Paris.
38. Mines and metallurgy	September 2 to 11	M. Castel, 144, Boulevard Raspail, Paris.
39. Money	September 11 to 14	M. Magnin, The Bank, Paris.
40. Otology and laryngology	September 16 to 21	Dr. Duplay, 2, Rue de Penthièvre, Paris.
41. Participation in profits	July 16 to 19	M. Robert, 15, Rue de la Banque, Paris.
42. Peace	....	M. Passy, 8, Rue Labordère, Neuilly-sur-Seine.
43. Periods of rest from work	....	M. Léon Say, 21, Rue Fresnel, Paris.
44. Pigeon training	July 31 to August 3	M. Janssen, Observatoire de Meudon, Seine-et-Oise.
45. Photography	August 6 to 17	M. Janssen, Observatoire de Meudon, Seine-et-Oise.
46. Physical exercises in education	June 15	M. J. Simon, 10, Place de la Madelaine, Paris.
47. Physiological psychology	August 5 to 10	Dr. Charcot, 117, Boulevard St. Germain, Paris.
48. Popular traditions	...	M. Ploix, Quai Malaquais, Paris.
49. Prehistoric anthropology and archæology	August 19 to 26	M. de Quatrefages, 36, Geoffroy St. Hilaire, Paris.
50. Primary education	August 11 to 19	M. Gréard, The Sorbonne, Paris.
51. Protection of monuments	June 24 to 29	M. C. Garnier, 60, Boulevard St. Germain, Paris.
52. Saving of life	June 12 to 15	M. Lisbonne, 3, Rue St. Vincent de Paul, Paris.
53. State aid in emigration	....	
54. State intervention in labor contracts	July 1 to 4	M. Donnat, 11, Rue Chardin, Paris.
55. State regulation of the price of food	July 5 to 10	M. F. Passy, 8, Rue Labordère, Neuilly-sur-Seine.
56. Statistics	...	M. Levasseur, 26, Rue Monsieur-le-Prince, Paris.
57. Stenography	August 4 to 11	M. Grosselin, Palais-Bourbon, Paris.
58. Share companies	August 12 to 19	M. Larombière, 16, Rue d'Assas, Paris.
59. Technical commercial education	July 8 to 12	M. Gréard, The Sorbonne, Paris.
60. Therapeutics	August 1 to 5	Dr. Moutard-Martin, 136, Boulevard Haussmann, Paris.
61. Unification of time	....	M. Faye, 95, Avenue des Champs Elysées, Paris.
62. Utilization of rivers	September 22 to 27	M. Guillemain, 55, Rue Bellechasse, Paris.
63. Veterinary medicine	September 19 to 24	M. Chauveau, 10, Rue Jules Janin, Paris.
64. Workmen's clubs	July 11 to 13	
65. Zoölogy	August 5	M. Milne-Edwards, 57, Rue Cuvier, Paris.

Further information concerning these congresses can be obtained by applying to their respective presidents, whose addresses are given above.

The meetings will be held in buildings within the limits of the exhibition, and detailed reports will be published of the proceedings. Persons desiring to take part in any of the congresses or conferences will have to pay a small fee for becoming a member of the particular class in the group with which he is interested.

As an illustration of the complete manner in which it is intended the congress work shall be carried out, we give a summary of the electrical congress prepared by the organizing committee; this congress was authorized by a ministerial decree, dated July 16, 1888; at the end of last year the committee had prepared its programme, and completed all its preliminary work. It has been decided that the congress shall open on August 24 next, and shall last over a period of eight days. The president of the commission is M. Mascart, the vice-presidents are MM. Fontaine, Gariel, and Lippmann; the secretaries are MM. Hillariet, Hospitalier, and De Nerville. Applications from all those who desire to assist at the congress should be addressed to the president, M. E. Mascart, 176 Rue de l'Université, Paris; the amount of subscription will be 20 francs = $4.

In a circular prepared by the commission it is pointed out that the international electrical congress held in Paris in 1881 had an importance the value of which could not be exaggerated. The decisions arrived at during that congress have been accepted all over the world, alike by men of science and by manufacturers. The Paris exhibition of 1889 suggests the necessity of a similar reunion, not only on account of the vast progress that has been made in electrical science since 1881, but also because many important problems which could not then be solved can now be approached with confidence on account of the great experience which has been obtained during the last eight years. The following programme has been drawn up by the commission for this congress:

First Section; Measurements.—Units; recent investigations on the unit of resistance; reports on electromagnetic and electro-static units; new practical units; instruments for measuring electrical energy, currents, resistances, electromotive force, capacity, induction coefficients, magnetic field, etc.; practical standards of current and electromotive force.

Second Section; Induction Machines. — Transformers.—Distribution. Recent progress in the theory and construction of generating and receiving machines; processes of automatic regulation; definitions and measurements of efficiency; comparisons between alternating and continuous current machines; transformers for continuous and alternating currents; mathematical investigations; measurements of efficiency; comparison of the two systems. Systems of distribution; canalization. Central stations; advantages and disadvantages attending the use of extremely high power machines compared with that of an equivalent group of small power machines; reserve machines; advantages and inconveniences of electrical and mechanical connections between groups of machines.

Third Section; Electro-Chemistry.—Batteries and accumulators. Different types employed in commerce; electromotive force, discharge, capacity, duration; cost price of electrical energy. Electrolysis; electromotive force necessary for commerical purposes; electrotyping; strength of currents, composition of baths, temperatures employed; their influence on the quality of depositions; separation and refining of metals. Electro metallurgy; electrical furnaces; electrical welding.

Fourth Section; Lighting.—The lighting of dwellings, workshops, and public thoroughfares; amount of light necessary for each case; measurement of light; distribution and intensity of the sources employed; comparison between the voltaic arc and incandescent lamps; high power incandescent lamps. Regulators; means employed for reducing resistances and lamps. Incandescent lamps; new methods of manufacture; their efficiency and duration. Methods of working central stations.

Fifth Section; I. Telegraphy.—Use of machines for the production of currents; installation, employment and duration of underground lines; overhead lines; apparatus for rapid transmission; multiple telegraphy; lightning conductors. II. Telephony. — Improvements in telephones and microphones; batteries. Establishment of lines; effects of induction; long distance telephony. Organization of central stations; commutators. Subscription and public stations; the use of one line for several stations. Service regulations; statistics and legislation. III. Miscellaneous Applications.—Electrical clocks; chronographs; recording apparatus; signals; applications to military and naval service and to public works; earth currents.

Sixth Section; Electro-Physiology.—Comparison of effects obtained in the use of various medical apparatus; the necessity of defining the nature of currents employed. The nature of electrical phenomena observed in living beings. The effect of continuous and alternating current discharges upon animals. Electrolysis of tissues; precautions to be taken in electrical installations.

Prospects for Steel Rails.

The latest rumor in steel rail circles is that steel rails will be down to $25 before midsummer. The strongest basis for that rumor is that two western Pennsylvania mills are competing for trade, and that one is determined that the other shall not have business at $26. The latest steel rail improvements have been adopted by steel rail manufacturers to reduce cost of production to the lowest point ever known, and as there is not enough business to go around, those who can discount quotations from one to two dollars per ton below others will secure the first rush business. Nothing has as yet been settled with reference to the talk of shutting down for the summer. Heavy iron ore contracts are being placed every day. Pig iron production has not been curtailed in any section of the country. Railroad companies have quietly undertaken to modify freight rates to purchasers from furnaces. Bar mills throughout the country are working but little over 60 per cent of their capacity, plate mills 70 per cent. Pipe mills are booking a good many orders. The coal trade is extremely dull, but there are signs of improvement. Coke makers find it difficult to maintain prices under the heavy output. There is a strong confidence that in two or three weeks more a general improvement will set in. Foreign iron and steel makers are quite active. Marine engine building and ship building are brisk, and companies doing such business are quite full of work, and a better condition exists than has been known for several years. Railroad building is not being pushed with the accustomed energy, but railroad promoters assert that, as soon as conditions warrant it, renewed zeal will be manifested in not only the newer sections of the country, but in the older, in which there is at present a superabundance of railway facilities.—*Railway Review.*

Weak Hearts.

A weak heart seems to be decidedly more practically inconvenient than a weak head. If a man or a woman be a little feeble about the region of the brain, it is generally of little moment. Some post or other will be provided if the conduct be respectable; and lack of brains is too common to excite any particular attention either in the person concerned or in those about him. But a weak heart insists upon putting itself in evidence at all sorts of convenient and inconvenient times. If its possessor finds himself rather late for his morning train, and makes a "spurt" to recover lost time, the exertion is usually followed by such a "bad quarter of an hour" that he resolves in future rather to lose a dozen trains than to risk temporary suffocation or permanent syncope again. The practical evils which are associated with a feeble heart are innumerable, and will readily suggest themselves to those who possess so unsatisfactory a pumping engine. Weak hearts are by no means so common as is often supposed. Many a man who thinks he has got one is merely dyspeptic; many a woman owes her symptoms to tight lacing or insufficient feeding. If the dyspepsia be cured, or the tight lacing be dispensed with, the symptoms of heart weakness will disappear. Even when the heart is genuinely "weak," the weakness is not always due to special disease of that organ. It may be only part of a general weakness of the whole system, which is easily curable. The late Sir Robert Christison, one of the most eminent of British physicians, used to smile at certain persons who were always complaining of weak hearts. "Gentlemen," he would say to his students when lecturing on digitalis, "gentlemen, the best tonic for a weak heart is a good brisk walk." Not a doubt of it. The majority of weak, flabby hearts are weak and flabby because every other muscle in the body is weak and flabby, and this general weakness and flabbiness is due to want of vigorous use. Exercise of the legs and back and arms gives additional and much needed exercise to the heart, and the heart grows strong by vigorous exercise exactly as every other muscular organ does, for the heart is a muscle. If a man has no organic disease of the heart, no enlargement, and no functional disorder, plenty of brisk walking, with occasional running, will soon dispel his breathlessness and heart weakness, other things being equal. The muscular inactivity of the modern town man is the parent of more ill health than any other single cause whatever.—*Hospital.*

Separating Minerals.

Mr. Carus-Wilson has devised an effective dry method for separating the denser minerals from sand. A piece of cardboard about 2 ft. long is bent in the form of a shoot or trough (it must not be allowed to break), and held in this form by elastic bands at either end; this must then be held, or fixed, at an angle sufficiently inclined to allow the sand to travel slowly down the shoot on being gently tapped. A small quantity of the sand to be treated is now placed at the head of the trough, which is then tapped with the finger. When the trough is tapped, the sand travels slowly down, and in doing so the denser grains lag behind, forming a dark mass in the rear of the stream; this dark mass increases as the sand flows on, and must be collected and placed in a receptacle just the moment before the last tap would cause it to fall off the trough. When a sufficient quantity of this denser sand has been thus collected, it should be placed in the lid of a cardboard box (about 12 in. by 6 in.), and gently shaken to and fro at a slightly inclined angle, the mass being at the same time gently blown upon with the breath. The finer quartz grains will thus be blown away, and hardly any but the denser grains will remain.

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Lowering the Freezing Point.

At a recent meeting of the Chemical Society, London, a paper was read on the application of Raoult's depression of melting point method to alloys, by Messrs. C. T. Heycock and E. H. Neville.

As a result of some preliminary experiments on the change in the solidifying point of tin caused by the addition of small quantitie of other metals, the authors conclude that the dissolution of a metal in tin follows the same laws as that of compounds in other solvents, *i. e.*: 1. That the fall in temperature of the solidifying point is directly proportional to the weight of metal added; and 2, that the fall of temperature is inversely as the atomic (molecular?) weight of the metal added. With tin, copper, silver, cadmium, lead, and mercury, the dissolution of one atomic proportion in 100 atomic proportions of tin caused a fall in temperature of the solidifying point varying from 2·16° to 2·67°, with aluminum a fall of 1·34°, and with antimony a rise of 2·0°.

In the discussion which followed the reading of these papers, Professor Armstrong said that notwithstanding the apparent regularity and simplicity of the results, he was not prepared to accept them as in the least degree final. There was not sufficient evidence in his opinion that the effect observed was not in part at least the outcome of a change in the molecular composition of the solvent. The results obtained by Raoult's methods were, he thought, comparable with those obtained by determining the specific heats of the elements. In the latter case the observations were undoubtedly made with masses of molecules, which probably were of varying degrees of atomic complexity, and yet the results were found to be such as to justify conclusions being drawn as to the relative magnitudes of their fundamental constituents—the atoms. In the same way it was possible that the results obtained by Raoult's method by means of observations on the behavior of molecular complexes might afford the means of deducing the relative magnitudes of the fundamental molecules comprising the complexes, but not of the actual complexes operated with.

Mr. Crompton drew attention to Beckmann's recent experiments on the lowering of the freezing point. These show that the true molecular weight was only obtained when solutions were used the concentration of which was allowed to vary only within certain narrow limits, and that if the solutions were too dilute the molecular weight obtained from the lowering of the freezing point was too low, while if the solutions were too concentrated. it was too high. In some cases the variation of the number obtained with the concentration was enormous.

Professor Carey Foster remarked that much depended on the definition given of a molecule, whether it is defined as that smallest quantity capable of existence *per se*, or as that quantity which produces a given effect in depressing vapor pressure, or freezing point, etc. The two mganitudes were not necessarily the same. The relation observed could hardly be accidental, yet he thought that the value obtained might be a quantity connected with the molecular weight, but not necessarily identical with it. Professor Ramsay, in replying, said that substances in dilute solutions must be regarded as in the gaseous state, their molecules being so far distant from each other as not to exert appreciable attraction on each other, and as occupying but a small portion of the space they inhabit. It has long been argued that the molecular complexity of the gases, hydrogen, oxygen, and nitrogen, must be the same, inasmuch as these elements have equal coefficients of expansion within the widest limits of temperature.

A similar argument applies to substances in dilute solutions. It is much more probable that they have a simple and similar molecular structure than that the molecules, if complex, dissociate to an equal extent on equal rise of temperature, or on equal alteration of concentration. As regards the empirical nature of Raoult's laws, it is paralleled by the empirical nature of Boyle's and Gay-Lussac's laws—that is, such laws are merely approximations to truth, and depend on the fact that the molecules are sensibly beyond the sphere of each other's attraction, and themselves occupy no appreciable space. Hence their inapplicability at high concentrations.

Low Level Health Resorts.

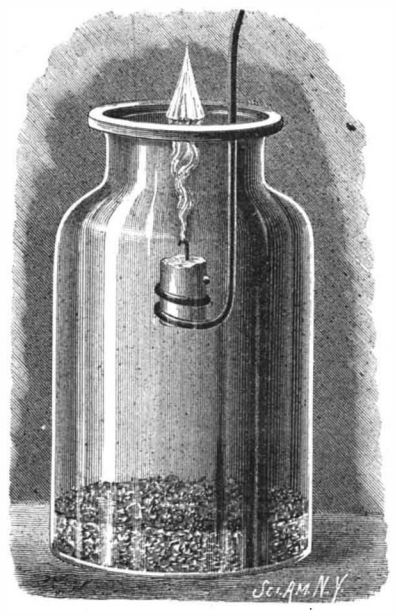
Attention has lately been called by Dr. Lindsey to the therapeutic value of regions below the sea level, for asthmatical or consumptive patients, who there have continuously higher atmospheric pressure than at the sea level. Excellent effects have been thus obtained in the valley of Conchilla, near Los Angeles, in California, about 273 feet under the sea (barometric pressure only about 7 mm. higher). The most noteworthy place of the kind on the earth's surface is probably the Dead Sea district (—1289 feet), and the following are some others: Lake Asal in East Africa (—639 feet), the oasis of Araj in the desert of Lybia (—270 feet), the Arroyo del Muerto in California (—230 feet), the oasis of Siwah in Lybia (—123 feet), the borders of the Caspian (—86 feet?

A SCIENTIFIC WILL-O'-THE-WISP.

T. O'CONOR SLOANE, PH.D.

A very interesting experiment that illustrates the phenomena of combustion, destructive distillation, and the relative specific gravity of gases is illustrated in the cut accompanying this article. The experiment depends upon the well known fact that an organic substance containing hydrogen when heated to a high temperature evolves gas. This is seen in the candle. The body of the flame is composed of gas evolved by destructive distillation from the organic material of which the candle is composed. This material is melted by the heat of the flame, is drawn by capillary action into the wick, and is there heated to so high a degree as to evolve a large amount of gas. A well known experiment used to prove the presence of this gas consists in lowering into the flame the end of a glass tube held nearly vertical. The hot gas from the interior of the flame rises through this and can be lighted at its top several inches distant from the flame.

There is a simpler way of showing it, which requires still less apparatus. If a candle is lighted and allowed to burn a few minutes, the wick becomes very hot. If it is now blown out, enough heat will be present in the wick and its contents to cause the evolution of combustible vapor. It can be recognized by a white column of vesicular matter rising like a fine mist from the candle. If a lighted match is held in this rising column a few inches above the candle flame, the vapor will ignite and will carry the flame down to the wick with a quick flash, and the candle will be relighted. It follows that, if the residual heat left in the wick is sufficient for the evolution of this amount of gas, the far



A SCIENTIFIC WILL-O'-THE-WISP.

hotter flame acting on the same material must evolve still more.

In the experiment shown in the cut some features of the last described phenomenon are utilized to produce what may be called a parlor will-o'-the-wisp or *ignis-fatuus*. A wide mouthed bottle, such as a pickle or preserve jar, is filled with carbonic acid gas. To do this a quantity of sodium bicarbonate or baking soda is placed in it and more acid is poured over the dry salt as it lies on the bottom of the jar. Dilute sulphuric acid is perhaps the best, but muriatic acid or even vinegar may be used. A very rapid evolution of gas begins, and in a few seconds the jar is filled and overflowing. A candle should have previously been attached to a piece of wire and should be lighted before the acid is introduced. This will give it time to get hot and into full combustion. The jar being filled with gas, the candle is gently lowered into it. The flame surrounding the wick is extinguished as it reaches and is lowered down into the carbonic acid gas, but if all is rightly managed, the flame will continue to burn on the surface of the gas like a veritable *ignis-fatuus*. The residual heat of the wick and material absorbed by it is sufficient to cause the evolution of a quantity of gas. For several seconds this rises up through the heavier carbonic acid gas, and burns upon its surface. A faint cloud of vapor may sometimes be seen, which indicates the ascending column.

After a few seconds the disconnected floating flame disappears for want of nutriment. The candle may now be removed and relighted, and a variation upon the experiment may be shown. It is again lowered into the gas in the jar, and is extinguished, leaving the same floating flame. But before the latter expires the candle is steadily raised. As it reaches the flame and emerges from the jar, it is lighted again, and continues to burn as before. The flame that it left behind it on the surface of the carbonic acid gas acts like the match in the experiment last alluded to, and relights the wick.

To perform the experiment successfully, the air of the room must be very still and undisturbed. In place of the candle a small glass jet may be used connected to a gas burner. The gas will rise from the jet immersed in the jar and will burn upon the surface as in the case of the candle. But the experiment is not as full or complete as when the candle is used, and it is not easy to obtain so distinct and marked a separation between the source of gas and the flame when ordinary gas is employed.

Funeral of M. Chevreul.

The public funeral of M. Chevreul, which took place in Paris, on April 13, was one of great splendor. This was due in part, no doubt, to the interest excited by M. Chevreul's extraordinary age; but it must also be taken as a striking indication of the respect felt in France for men who achieve eminence in science. In front of the house in which M. Chevreul died, beside the Jardin des Plantes, a tent was fitted up as a chapel, and here the body was placed in state. The procession to the Cathedral of Notre Dame was headed by a detachment of police, who were followed by a platoon of cuirassiers, the 103d Infantry Regiment, with flags, and a band of ushers, carrying wreaths presented by the stearine makers of France, the stearine makers of Lyons, the Friendly Society of Natives of Anjou, living in Paris, and a large number of other public and private bodies. Last of all came a wreath sent by the Gobelin Works surrounded by a woolen fringe dyed by M. Chevreul himself. The pall bearers were MM. Fallieres, Minister of Public Instruction, Louis Passy, President of the Society of Agriculture, Chaumeton, President of the Students' Association, Des Cloizeaux, of the Academy of Sciences, Quatrefages, of the Academy of Sciences, Chautemps, president of the Municipal Council of Paris, and Roy, manager of the Society of Arts and Manufactures. Next came the members of M. Chevreul's family, grandchildren and great-grandchildren; and they were followed by the representatives of the President of the Republic, by several of the ministers, the presidents of the Senate and the Chamber, and representatives of all the great educational and scientific bodies and administrative departments. At Notre Dame there was an impressive religious service. The interior of the church was hung with black, and over the porch, which was also hung with black, was a scroll bearing the dates "1786–1889." In the center of the choir was a catafalque resting on silver columns, and surmounted by a canopy with bands of ermine. After the religious ceremony, the body was removed to L'Hay, and interred in the family vault. In compliance with M. Chevreul's last wishes, no speech was made over his grave.

The New Subway, London.

A paper was read lately before the Junior Engineering Society, London, by Mr. W. T. Dunn, hon. secretary, on "The Southwark and City of London Subway," in connection with which a visit took place to the works of the undertaking, permission having been granted by Mr. J. H. Greathead, the engineer. Entrance was obtained to the underground workings at the New Street station of the line, Kennington Park road, the visitors being accompanied by Mr. Basil Mott, resident engineer, who explained the construction of the workings, the position and proposed fittings of the platforms, and arrangements for entrance and exit, and the general manner in which the work at present completed had been carried out. The party then proceeded for a short distance along the down tunnel cityward, afterward passing through a connecting passage into the up tunnel. From thence they passed to the section of the tunnel leading in the direction of Kennington, and during their progress the method of constructing the tunnel was fully seen and explained, the principal features of interest being the boring shield, worked by hydraulic rams, the manner of fixing the segments of the cast iron tunnel lining, and the apparatus employed for injecting the cement grouting under air pressure.

The Great San Diego Flume.

It is claimed that the recently completed San Diego flume, described in the SCIENTIFIC AMERICAN of October 27, 1888, is the most stupendous ever constructed in the world, being only a little short of thirty-six miles long. An idea of the gigantic character of the work may be obtained from the fact that the amount of lumber consumed was more than nine millions of feet, or, allowing the very considerable yield of 1,000 feet to each tree, not less than 9,000 trees were required. In the course of the flume there are some 315 trestles, the longest of these being 1,700 feet in length, eighty-five feet high, and containing one-quarter of a million feet of lumber. Another trestle is of the same height, and 1,200 feet long, the main timbers used in both of these being ten by ten and eight by eight, being put together on the ground and raised to their position by horse power. The number of tunnels in the course of the flume is eight, the longest of which is 2,100 feet, the tunnels being in size six by six feet, with convex-shaped roofing; each mile of the flume required an average of one-fourth of a million feet of lumber for its construction, and the redwood used entirely in the box is two inches in thickness throughout.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING.—Robert L. Breth, New Washington, Pa. This invention provides a coupling gate and a detachable frame adapted to be placed over a drawhead, in which a rubber buffer is fitted, there being a coupling hook and a lifting lever for the gate, the device being applicable to ordinarily constructed drawheads, and obviating the necessity of train hands going between the cars.

CAR COUPLING.—Alexander H. Grant, Hobart, N. Y. This is a construction by means of which the coupling pin may be held up in position for coupling, may be automatically coupled by the action of the link, will be prevented from jumping out of its seat, and will not become bent, and with which also high and low cars may be coupled.

Electrical.

TELEGRAPH SOUNDER.—Frank L. Van Epps, Hudson, Mich. Combined with the armature lever and the standard, having registering curved recesses on their lower and upper surfaces, is a roller bearing piece in the recesses, whereby the bearing of the armature lever will be non-adjustable, and the wear of the armature lever will be automatically taken up.

Mechanical.

WORK REST FOR BENCHES. — Alexander Watson, Brookline, Mass. This is an adjustable rest especially designed for use with wood-working machines, being a simple device for effectively supporting the back end of work at the face of the bench, while not protruding to tear or injure the workman's clothes, and one which can be readily adjusted and locked at any required position to support work of different dimensions.

FEEDER FOR BAND SAWS.—Abram B. Springstead, Kalamazoo, Mich. This invention relates to means for gauging and feeding the work, affording a convenient device for attachment to the work table, whereby annular or wheel segments of any desired radius may be readily cut from the stuff worked, and the ends of the stuff rounded to any desired curve.

GIN SAW CLEANER.—George P. Melchior, Bellevue, Miss. This cleaner consists of a shaft having a series of disks, and formed with peripheries of reduced thickness provided with laterally projecting rings of brushes, being an attachment permitting the gin to operate upon wet or d mp cotton without clogging the saws and ribs and without injuring or napping the lint.

SPRING MOTOR. — Annie W. Pearce, Greenwood, S. C. This motor consists of a casing in which spring-actuated gearing is mounted, one of the gear shafts projecting at each side of the casing and having a disk with arms adapted to detachably connect the motor with the drive wheel of the machine to be driven, the device being adapted for use with sewing machines, dentists' and jewelers' drills, etc.

Miscellaneous.

OVEN THERMOMETER.—John C. Voss, El Paso, Texas. Combined with a spindle having a lever and an index or pointer is a compound bar secured at one end and bearing at its free end against one side of the lever, the device affording an instrument for indicating the temperature of an oven, so that the fire may be regulated for different articles.

MECHANICAL TELEPHONE. — William W. Nichols, New York City. Diverging or radial flat metal plates are combined with the diaphragm, and held under constant tension in contact therewith by the line wire, to distribute the vibrations and relieve the diaphragm of strain, the line wire connection being made by a button resting centrally on the plates, a small stud or shank of the button passing centrally through the diaphragm.

WATERPROOFING STRAW GOODS. — Runyon Pyatt, Jr., New York City. This invention consists in a process of treating the goods to a bath of resin dissolved in water and sal soda, drying them, and neutralizing the effect of the alkaline solution by an acid bath, the process preserving the natural color and imparting a substantial body to the goods.

FISHING NET FRAMES. — John G. Landman, Brooklyn, N. Y. This invention relates to a hinge-screw coupling adapted more particularly for securing a collapsible scalp net frame to a handle, preferably by a ferrule, and in distended condition for use, the device being also applicable for coupling and holding firmly other collapsible structures.

FLOUR BOLT.—John Johnston, Neenah, Wis. This invention provides for the movement of the sieve in any desired direction, and for it to be carried to and fro elliptically by means of shafts, while the hanger connections provide for a proper adjustment of the sieve frame, and by adjustably connecting the crank pins the path through which the sieve is carried may be varied according to the requirements of the material to operate on. In a further patent the same inventor shows a shaking bolt having some of the same general features, with a swinging hopper apron or plate, and with different means for suspending and adjusting the apron or plate, and imparting a circular or elliptical movement to the sleeve.

VEHICLE WHEEL. — John O. Leck, Glen Elder, Kansas. Clips are secured on the approaching ends of the felly sections, with spaced teeth adapted to interlock when brought together, with a wedge fastening, whereby the tire, should it become loosened, can be set without heating or shrinking, and without removing the tire from the wheel.

DOG FOR LOG CARS. — Robert J. Thompson, Grandin, Mo. Combined with the bolster or cross beam of the log carrier are dogs pivoted near the opposite ends of the beam, push bars being connected at one end to the dogs, and toggle levers connected at their outer ends to the push bars, with an operating lever with the pivoted ends of the toggle levers, whereby the logs may be retained in position and expeditiously released.

WAGON END GATE. — William R. Watt, Somerville, Tenn. This is a simple and durable fastening for locking the end gate, the invention consisting of a shaft mounted to turn and slide in the end gate and having a fixed head adapted to engage a recess in the cleat holding the end gate.

WAGON BED.—This invention, also by the above inventor, consists of L-shaped metallic cleats secured to each side of the wagon bed and forming a guideway for the end gate, the cleats each having at its outer end a bolt passing through the bed proper, and a nut screwing on the lower end of each bolt and against the under side of the bed bottom.

HOISTING ATTACHMENT. — John F. Schultz, New York City. This invention relates to an apparatus for loading barrels or boxes of ashes or garbage into collecting vehicles, providing therefor an elevator attachment capable of being transformed into sideboards and an extra tailboard, when not in use as a hoisting device, to form an extension of the vehicle body, and prevent its contents from falling off.

SCAFFOLDING. — Adolph Bitterly, Ottawa, Ill. This scaffold is made with two triangular legs or frames, having cross rods between their ends and removable bolts at their adjacent narrow ends, with other novel features, the construction being adapted for building chimneys, plastering, painting, etc., while being easily set up or taken down and packed in small space.

BAG HOLDER. — Frank A. Brown, Angelica, N. Y. This is a holder for bags while being filled, and is made of wires bent to form two outwardly and downwardly projecting side arms, terminating in hooks, and twisted and bent in the rear, forming loops, with a back having upper and lower extensions, the device being supported in position simply by hanging it upon a nail or the edge of a bin.

HINGED HANDLE.—Jacob Gerstle, Portland, Oregon. This invention provides a hinged handle designed for attachment to frying pans and other culinary vessels, the handle being adapted to fold down in compact form when the vessel is not in use, while it can be opened out and held in rigid position by a simple movement of a sliding fastener.

SCIENTIFIC AMERICAN

BUILDING EDITION.

MAY NUMBER.—(No. 43.)

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1. Elegant plate in colors, showing elevation in perspective and floor plans for a dwelling costing four thousand dollars. Page of details, etc.
2. Plate in colors of a summer cottage for one thousand two hundred dollars. Floor plans and page of details.
3. Design for a bank building, with plan and view of interior.
4. Perspectives and floor plans of an elegant residence at Bell Haven Park, in Greenwich, Conn. S. Edwin Tobey, Boston, Mass., architect.
5. A mountain cottage lately erected at St. Cloud, Orange, N. J. Elevation and floor plans. Architect Mr. Arthur D. Pickering, New York.
6. A dwelling at Springfield, Mass. Plans and perspective elevation. Cost eight thousand five hundred dollars.
7. Engraving showing perspective elevation of a cottage erected at Roseville, N. J., at a cost of six thousand seven hundred and fifty dollars. Floor plans. F. W. Ward, architect, New York.
8. Illustration and floor plans of a combined school house and country cottage erected at St. Cloud, Orange, N. J. Arthur D. Pickering, New York, architect.
9. A residence at Springfield, Mass. Perspective elevation and floor plans. Cost three thousand five hundred dollars. J. D. & W. H. McKnight, architects.
10. A cottage built at Roseville, N. J., for six thousand seven hundred and fifty dollars. Elevation and floor plans.
11. A cottage at Holyoke, Mass., lately erected for Howard A. Crafts, at a cost of three thousand one hundred dollars.
12. View of Auburndale Station, Boston and Albany Railroad, with plan of station grounds. H. H. Richardson, architect.
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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(872) E. T. W. asks for the receipt for marbleizing glass. A. It may be done by painting or by picking up color from the surface of water. For full description we refer you to articles on marbleizing wood and paper in Spons' Workshop Receipts, 1st series, which we can supply for $2.

(873) W. I. L. writes: I wish to contact zinc with glass to bear considerable pull without parting. Can you suggest an inexpensive cement, composition, or any substance that will answer the purpose? A. Many receipts are given; 1 pound of shellac dissolved in 1 pint alcohol, with one-twentieth its volume of a solution of gutta percha in bisulphide of carbon, will dry quickly. A slow-drying one may be made thus: 2 ounces thick glue solution, 1 ounce linseed oil varnish or ¾ ounce Venice turpentine; boil together.

(874) A. F. J. asks how to find the length of a chord when the length of the arc and radius is given. I want to put 16 pieces together to form a circle of 20 feet diameter. Also how to find the versed sine, and what will be the factors of the previous example? A. The best way is to do it by a table of circular functions. Thus 1/16 circle = 360°/16 = 22½°. Twice the sine of one-half this angle is the chord; in your problem it must be multiplied by the radius, 10 feet, giving 45 inches. The cosine of one-half of the angle subtracted from the radius gives the versed sine, in your case 4·8 inches.

(875) C. W. S. asks how many foot pounds are obtained by the explosion of one pound of hydrogen gas mixed with the right proportion of air, also how many mixed with pure oxygen. A. One pound of hydrogen gas combining with eight pounds of oxygen gas will liberate 34,170 (Centigrade degrees) heat units. This multiplied by 1409 (pound degree Centigrade equivalent in foot pounds) gives 47,940,510 foot pounds. A small reduction must be made in practice for the heat absorbed in heating the nine pounds of steam produced. The result for air will be nearly the same.

(876) E. K. asks (1) what to use to dissolve boracic acid so as to make a concentrated solution of it, to use when cold, which will not precipitate. I want to use as anti-oxidizing soldering solution for gold. They have some way of dissolving it without using hot water, because it reprecipitates. A. Use hot glycerine or alcohol. 2. What is the best analytical qualitative chemistry, that is, for all around work? A. We recommend "Manual of Qualitative Chemical Analysis," by C. R. Fresenius, $4. 3. Can you furnish me with a watch maker's manual? A. We can supply you with Saunier's "Watchmaker's Hand Book," $3.50, also Saunier's "Modern Horology," $16.

(877) Punjabee asks: 1. What should be the dimensions of an electric magnet so that it would attract and pull through a space of 1/8 inch or 3/8 inch a weight of about 150 pounds? What size and weight of covered wire should be wound on the magnet? A. In the SCIENTIFIC AMERICAN, No. 19, current volume, page 291, you will find a description of such a magnet as you require. 2. How many pairs of zincs and carbons, each ½ in. diameter by 6 inches long, all fixed close together without touching, and connected in series, and the whole immersed in a large vessel containing the ordinary bichromate solution, would operate the above magnet? A. Your proposed arrangement of battery is not advisable, better make 6 or 8 separate cells, each having a plate of zinc 3 x 8 inches and two carbon plates of the same size, or in lieu of the carbon plates use 10 or 12 carbon rods such as you describe. 3. I have a big horseshoe magnet (compound) built up of 8 plates each 1½ inch by ¼ inch. This magnet has lost its virtue through having been thrown to one side in a large store, and so neglected for some years. A little of its attractive power remains, but is very feeble. How could I make it regain its power? I have not the means of going through the ordinary magnetizing process, but I could get the use of a large dynamo, which lights our workshop, if it would answer the purpose. This you could please let me know, and how to go about it? A. You can remagnetize your magnet by placing its poles in contact with the poles of the electro-magnet before referred to.

(878) A. B. asks: 1. What weight would field magnets of motor in SUPPLEMENT, No. 641, be capable of sustaining if used as an electro-magnet, with same current as required to run motor? A. It depends upon the amount of current used. With 6 cells of plunging bichromate battery it would probably support 100 pounds. 2. How can I make an induction coil give a direct current? A. By arranging a commutator to correct the currents as they are discharged from the coil. 3. Is the commutator only necessary for revereing and stopping the current of the induction coil? A. No induction can take place with a continuous current. 4. Would a ridge of wood left in the center (where secondary is divided) of the spool answer the purpose of the insulating material? It would be easier winding, I think. A. It would answer the purpose if boiled in paraffine or wax. 5. I have pound and a half of size wire inclosed. Please state if it will answer purpose of secondary coil. A. Your wire will answer, but it is rather coarse. 6. Please give me the address of some reliable electrical supply company. A. Consult our advertising columns for dealers in electrical supplies.

(879) Interested writes: 1. I have a gold ring which has been near sulphur; the latter darkened the ring, in the engraving particularly so. What shall I do to restore it to former color without injuring stone, which is a cut "tiger's eye"? A. Polish with a brush, using whiting, soap, and water. 2. Is there any simple preparation that can be put on a photographic proof to prevent its fading? A. Soak in solution of hyposulphite of soda. It should properly be toned, but is generally not dark enough to give good results. Many formulæ for toning have been given in our columns and in the SCIENTIFIC AMERICAN SUPPLEMENT. 3. I had a receipt for silver ink, but cannot find it. Can you give formula for same? A. Rub up silver leaf or silver bronze powder with honey and water.

(880) E. M. writes: I have made a Wimshurst machine, described in SUPPLEMENT, No. 548, which works splendidly, but the cement in setting cracked the glass; could you give me a formula for a satisfactory cement? A. Use the same cement, but interpose a piece of thin leather between the glass and its support. The leather should not be saturated with the cement, as it would when hardened render the leather very rigid.

(881) E. S.—You can run the dynamo described in SUPPLEMENT, No. 600, by means of horse power, by charging a storage battery, provided you are able to keep up a moderately even speed. It will take about 5 or 6 hours to charge the battery. For information on secondary batteries we refer you to Reynier's Voltaic Accumulators, price $3.

(882) N. T. G. asks (1) what ingredients compose the liquid ink eraser used for erasing blots, etc., from paper. It is used with a camel's hair brush, and consists of one or more kinds of acid. A. We do not know the particular eraser you refer to, but you can thus use a solution of oxalic acid in water, removing the liquid from paper with a blotter, and making one or two applications. 2. A receipt for making solder, that we find sold by agents throughout the country, for

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home use. The solder is melted with a common match. A. The fusible metal solder sold by peddlers is made with 50 parts tin, 25 parts lead, 25 bismuth.

(883) A. J. R. asks: What is the cheapest way to transmit 5 horse power 150 feet, to use it cutting feed to fill a silo? I use it but a few days each year. A. For only temporary use the cheapest means of transmission is by a rope ¾ inch or 1 inch (a tow line) running over grooved pulleys 3 or 4 feet in diameter. The pulleys may be made of pine wood and clamped to the driving shaft and to the machine shaft. When not in use the rope can be taken off and stored safe from the weather.

(884) J. W. B. — Stains on a ceiling should be carefully scraped enough to take off the old whitewash, and washed with clean water before re-whitewashing. Then whitewash with good white lime water with a little white glue dissolved in the water. An ounce of glue to a pail of whitewash is sufficient.

(885) C. W. G. writes: I have a griddle which I clean every morning with sapolio and a scrubbing brush, rubbing 15 to 20 minutes. The face is full of small ridges left from the grindstone. What can I use that will give it a smooth face? A. Rub the metal with a piece of leather wet with flour of emery and water, and finish with ground pumice stone on a cloth.

(886) J. E. L. writes: Will you let us know of a simple method of preparing chloride of silver, and how the powdered form is changed into a solid that can be moulded? A. Dissolve silver coin in nitric acid, warm the solution, and add hydrochloric acid and filter. The solid matter is chloride of silver. The filtration should be done in a room as near dark as possible. Allow it to dry in the dark. When all moisture has evaporated, it can be melted at a low red heat and cast into any desired shape in a mould. The mould may be of various materials, iron, clay, or even pasteboard if the heat is kept low.

(887) F. S. M. asks: Would a plunge battery of four cells, with a capacity of 1½ quarts of fluid per cell, and with zincs and carbons 5×6 inches, furnish any more power to run a motor if changed into a battery of eight cells of half the size per cell? What is the best way of connecting up the cells to get the most power? A. The proper arrangement of the cells depends on the motor used. The four cells arranged in series should work an ordinary small motor very nicely. Do not divide the plates and produce the eight cell battery. Procure a low resistance (1 to 2 ohms) motor and use the larger cells.

(888) C. E. P. asks how and by what process I can extract aluminum from the clay. I am a miner, and we run off large quantities of clay, and I might at the same time save the aluminum with perhaps a small extra expense. A. Aluminum can be extracted from clay by the use of metallic sodium or by the electric furnace. There is no way practicable for you, as it is an expensive and difficult operation and only available for experienced chemists. Richards on Aluminum gives details of processes; this we can supply for $2.50 by mail.

(889) R. M. P.—Ordinary house refrigerators use about 200 pounds of ice per week more or less. The drainage is through a half inch pipe sealed. For a ten or twenty thousand pound refrigerator a 2 inch pipe with seal is large enough. There is nothing suitable for the inside of refrigerators but metal, which may be zinc or galvanized iron, of which a deflector and drip trough may be made to catch the water of condensation falling from the bottom of the ice chamber.

(890) W. D. M.—The force of the tidal motion on the flow and ebb are contrary and balance each other. There is no known change in the earth's rotation from tidal causes.

(891) F. McF. — Violin varnish: Dissolve 12 parts sandarac, 6 parts shellac, 6 parts mastic, 3 parts elemi gum, in 150 parts alcohol. Warm when dissolved and add 6 parts Venice turpentine. Color to match the old varnish with Brazil wood and dragon's blood gum.

(892) H. M. writes: In forcing water through a hose will the pressure be the same at the discharge end as at the pump end? A. The pressure will not be as much at the discharge end of the hose as at the pump. The motion of the water through the hose causes friction, which retards the flow. When the end of the hose is closed, and with no movement of the water, the pressure is alike at both ends on the same level.

(893) O. A. P.—For a colorless lacquer dissolve bleached shellac in pure alcohol, settle and decant. Make the lacquer very thin. The usual lacquer for brass is made with ordinary shellac and alcohol made very thin, settled and decanted.

(894) E. D. asks: Will men peddling ink stands on commission have to pay a city or borough license or tax? A. Many towns or counties require peddlers to take out license. In some States, a State license is enforced, though this has been the subject of many suits, and has been declared unconstitutional except as a police regulation enforced alike upon citizens of the same and other States.

(895) F. R. asks the ingredients used, and in what proportion, in making hard oil finish. A. Hard linseed oil varnish is made with 750 parts linseed oil boiled with 150 parts litharge and 90 parts pulverized minium. Boil until it turns brown, then add 500 parts pulverized amber melted in 60 parts linseed oil. Boil and stir for a few minutes, cool, settle, and decant the clear varnish.

(896) J. H. A. asks: What is the composition of the skin colored material which dentists use in making artificial teeth? A. Pink celluloid or xylonite. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 227.

(897) J. B. S.—The height of the atmosphere is supposed to be about 50 miles. It is not positively known. The highest point jet attained by a balloon is about 5 miles. The thinnest sheet copper that is made is about 0·007 inch thick (33 wire gauge) and weighs 2·88 pounds to a square yard. Its breaking strain is about 21lb pounds to one inch width.

(898) F. G. D.—Steel springs are tempered in oil and reheated with oil on the surface until the oil blazes, then cool in oil. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 20, "How to Make and Temper Springs."

(899) A. P. asks: Is it possible to hatch 13 perfect chickens from 11 eggs? A. Yes. Twin chicks are occasionally brought out. They generally die young.

(900) J. A. S. asks whether there is any chemical known that can disguise the smell of kerosene and not impair its action as a washing agent in the boiling of clothes. A. No such agent is known. Kerosene can be subjected to additional purification with bichromate of potash and sulphuric acid.

(901) C. T. E. writes: 1. I spilled some kind of chemical upon some cloth goods (probably sulphuric acid) which left a vermilion stain. I applied some India ink and succeeded in removing the red color, but left a shiny spot which showed through the ink, the chemical leaving a glaze. Is there anything I could use to remove the greasy-looking glaze so produced? A. Wash the spot with ammonia and water. 2. What will bleach out an ordinary finished photograph, leaving ink lines which have been drawn over the picture? What is a silver print? A. Solution of mercuric chloride (corrosive sublimate).

(902) C. G. asks: 1. Is black a color? If it is not, how is it proved? A. Black is the absence of colors. This is evident, because when light, the source of all colors, is withdrawn, the eye is affected by blackness. See SCIENTIFIC AMERICAN, vol. 56, p. 137. 2. Is there anything that if you put it on your bait while fishing, will draw the fish? If so, what is it? A. We know of nothing that has any real value for this purpose. 3. What is smallage? A. A name for celery (*Apium graveoleus*).

(903) H. J. S. asks (1) how to make a liquid that will oxidize silver a glossy black by dipping small silver articles in the liquid. A. Use a solution of sulphide of potassium; polish metal before, and rub with a soft rag or chamois after immersion. 2. How to make a liquid that will oxidize copper or oroide by dipping, to imitate bronze? A. Use the same bath, but have it quite dilute. If for outside work simply oil with olive oil, and let the weather do the rest.

(904) M. H. & Co. ask for a recipe for making artificial cider. A. We give two formulas: *a*. 25 gallons soft water, 2 pounds tartaric acid, 25 pounds dark brown sugar, 1 pint yeast. Put in a clean cask with the bung out, and after 24 hours stir them well together. Add 3 gallons spirits, bung up the cask, and leave for 48 hours. *b*. Water 100 gallons, honey 5 gallons, powdered catechu 3 ounces, alum 5 ounces, yeast 2 pints. Ferment for 15 days in a warm place, in sun if possible, then add bitter almonds ½ pound, cloves ½ pound, burned sugar 2 pounds, whisky 3 gallons. If too sharp add honey or sugar, if too sweet add tartaric acid.

(905) H. P. B. asks (1) whether Portland cement or plaster of Paris would not do (for light work) in making the gas furnace described in SCIENTIFIC AMERICAN of May 4, 1889, page 279. A. Nothing is a good substitute; try to get pipe clay at the drug store; try mixing wood or coal ashes and sand with as little Portland cement as will hold it together. 2. Which of the previously named substances would give the best result, as clay is not available? A. Of the two, Portland cement is the best and may answer for low heats.

(906) J. B. O.—The powder sent may be a natural deposit of infusorial silica. Use powdered pumice stone as a polishing and cleaning agent and you will get probably equal satisfaction.

(907) Theo asks what to use to remove tan or sunburn. A. The following is recommended: 6 drachms avds. powdered borax; Price's glycerine ¾ ounce; use water or elder flower water 12 ounces; mix. We doubt the efficacy of any application except such as will cause the outer layer of the skin to strip off, such as the extract of cashew nuts. Even such a violent application does little good if the skin is re-exposed to the sun, as sunburn and freckles are liable to return as badly as ever.

(908) S. D. M. J. Co. writes: Please give us in your Notes and Queries a recipe to strip nickel off nickel plated goods. A. Use strong sulphuric acid 4 pounds, nitric acid 1 pound, water 1 pint. The mixture must be made gradually, adding the sulphuric acid first to the water, and adding the nitric acid after it is cool. The articles must be carefully watched and must be removed from the bath the instant the nickeling is stripped.

(909) S. K. A. writes: A certain writer says: "We were in a kind of chrysalitic condition." He refers to the state of a chrysalis. 1. Is his use of the word chrysalitic proper or sanctionable? A. We should be inclined to admit the word and the use made of it as allowable. "Chrysalid" is given by Webster as the adjective. 2. In good usage, is it proper for a compositor to divide the word Worcester at the end of a line, Wor-, carrying the balance of the word over to next line, as though it were a three-syllable word? A. Yes. 3. Can you refer me to any standard authority, in book form, on correct punctuation and the best usage of the English language, that would be an aid to compositors? A. We refer you to Hill's Manual of Social and Business Forms, $6; also Roget's Thesaurus of English Words and Phrases, $2.50, which we can send by mail.

(910) F. W. asks: In SCIENTIFIC AMERICAN, May 18, page 314, No. 799, you state how to preserve wood; would the sulphate of iron do for shingles? I have to lay about 50,000 hemlock this year. I think the tar would be too dangerous? A. We should not feel inclined to recommend iron sulphate, as repeated rainfalls would tend to wash it out. For shingles something more insoluble would seem better.

(911) J. B. asks: 1. How much pressure will mercury exert in a tube ½ inch diameter and 10 inches long, through expansion? A. There is hardly any limit assignable. As the heat increases the pressure will increase until it would burst almost any tube that did not expand as rapidly as itself. Thus for a change of temperature of 10° F. in a non-expanding vessel, mercury would exert a pressure of 2,850 lb. to the square inch. But as the containing vessel would expand with the heat, the absolute pressure would be somewhat less, but still very great. 2. Is there any solid that becomes heavier by immersion in water? A. No. 3. What would be the cost of the magnet described in SCIENTIFIC AMERICAN of May 11, 1889? A. About twenty-five dollars if you do some of the work yourself. 4. Is there any electric motor that is suitable for running sewing machines, and about what would they cost? A. For such a motor, see our SUPPLEMENT, No. 641, which we can send by mail for 10 cents.

(912) H. W. S. writes: 1. In case of a knot falling out of a board in a fence, is it caused by the board drying and shrinking away from the knot, or the knot drying and shrinking away from the board? A. We believe it is due principally to shrinkage of the knot. 2. If a hole was bored in a dry board, when the board became water-soaked, would the hole become smaller or larger in diameter? A. The hole in the wet board we should expect to find larger than when the board was dry.

TO INVENTORS.

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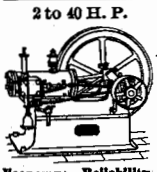

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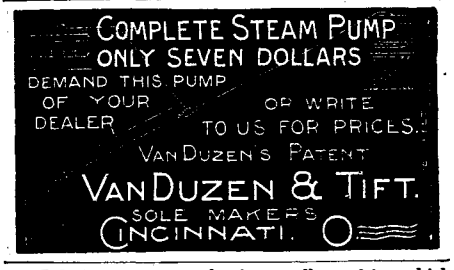

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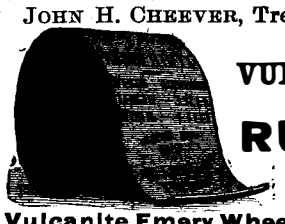

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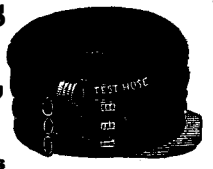

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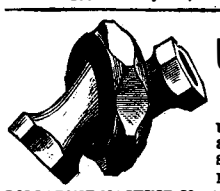

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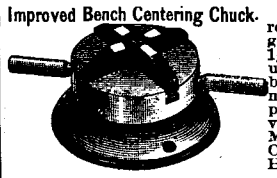

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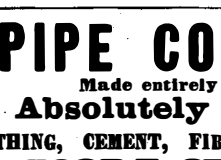

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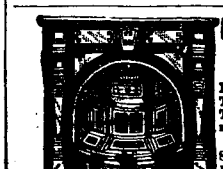

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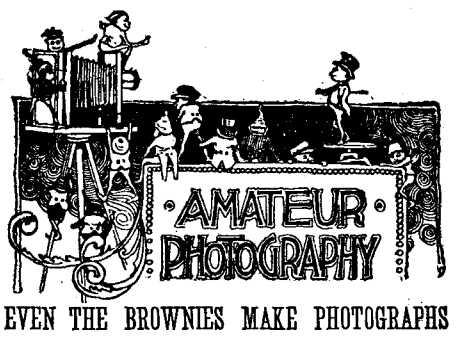

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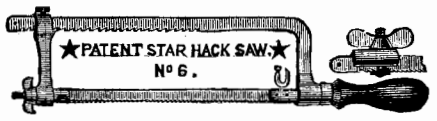

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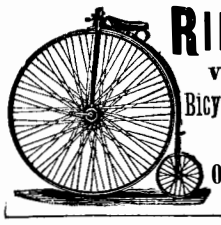

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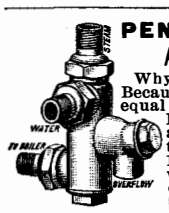

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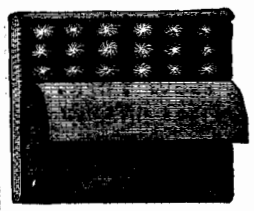

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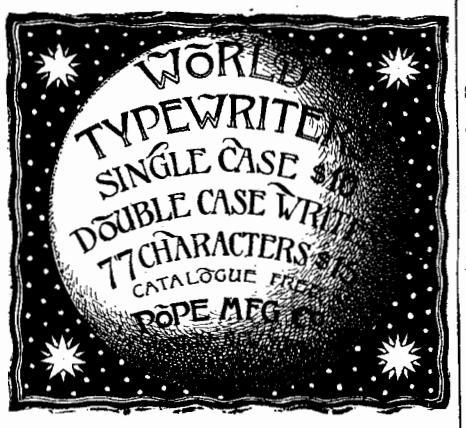

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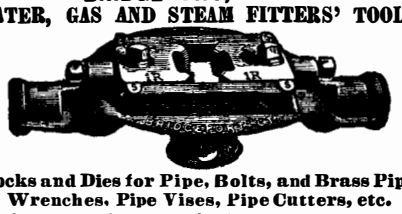

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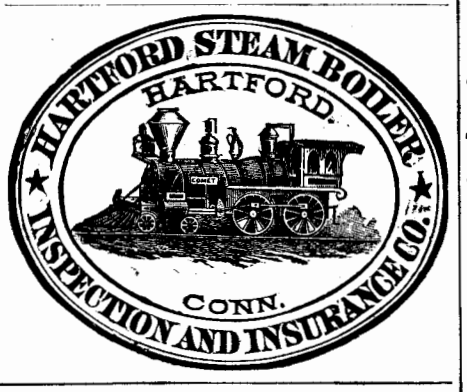

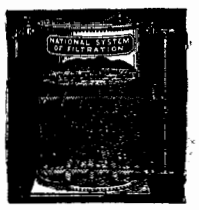

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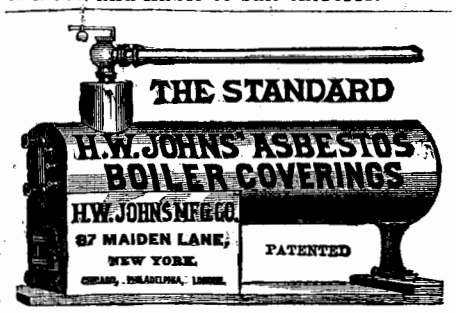

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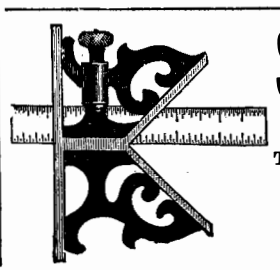

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